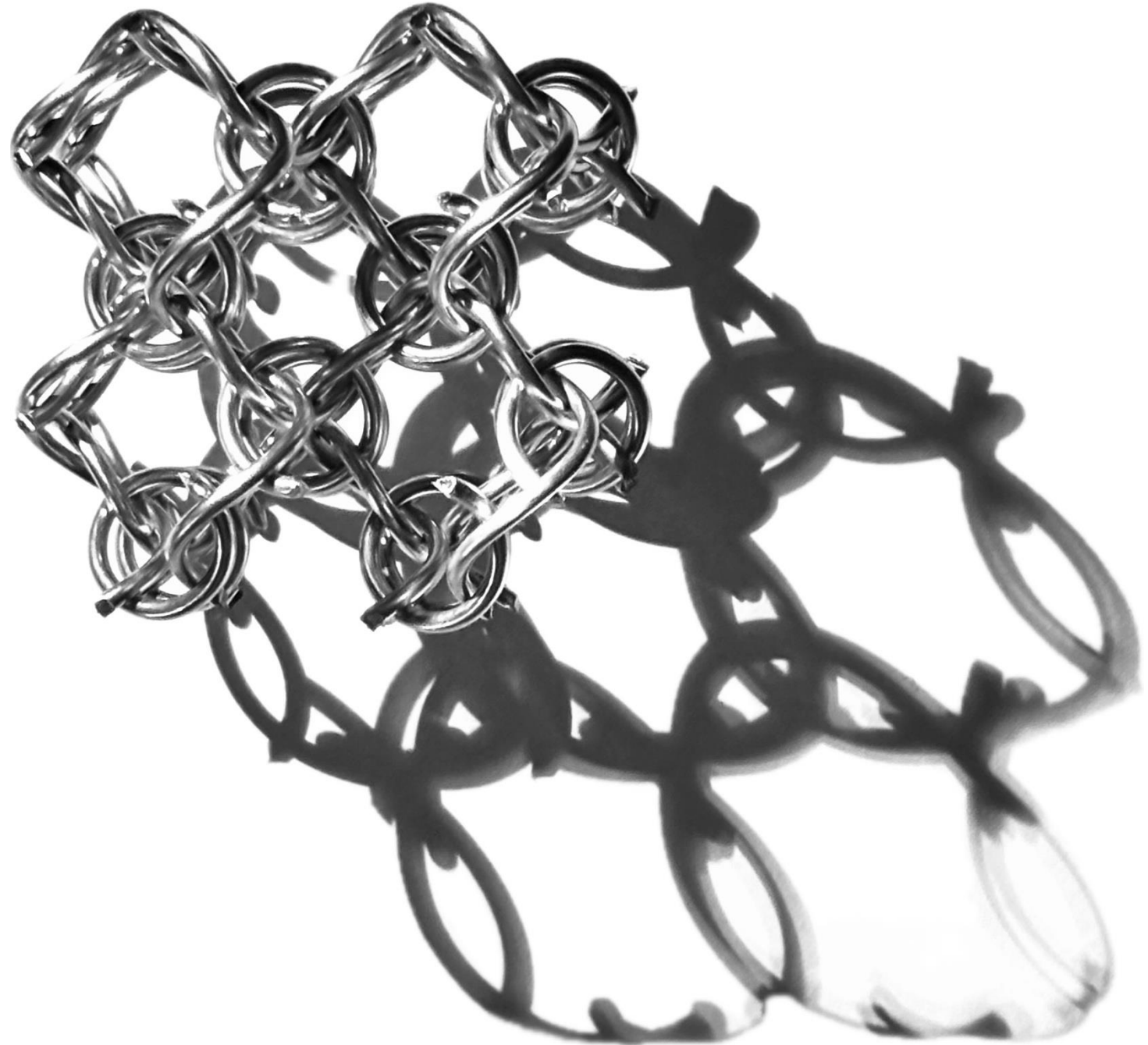


Wetzel's Weaves:

An Exploration of Periodic Helices

Duston Wetzel, Ph.D.
Presented for ISQGD
October 11th, 2026

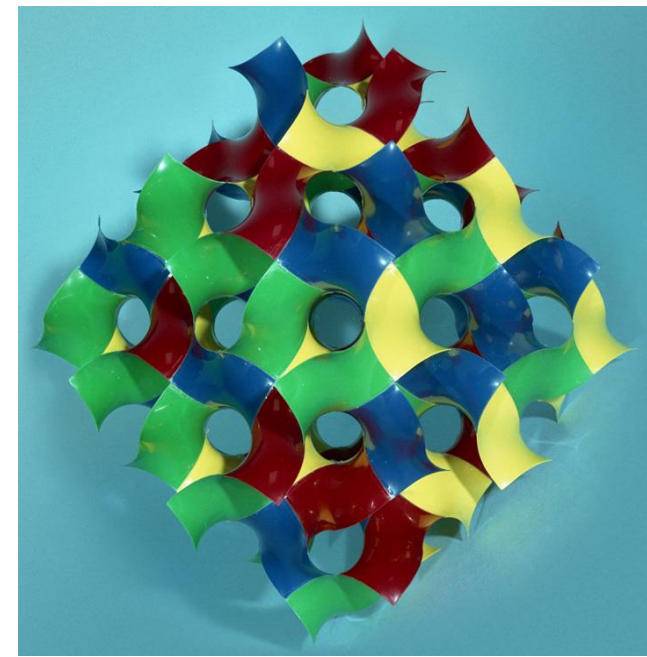




What is a gyroid?

One of many triply periodic minimal surfaces discovered by Alan Schoen (1968)

- Calculated Bonnet angle of 38.015° between Schwartz Primitive and Diamond surfaces
- Demonstrated vacuum-formed models

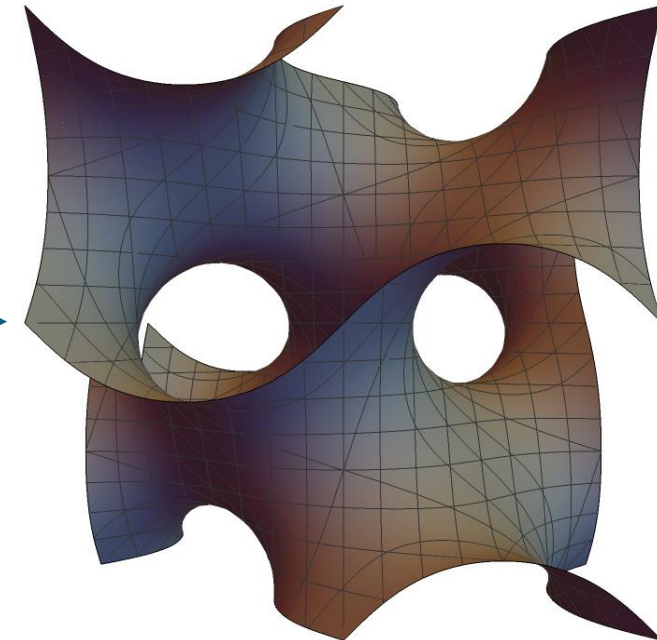


<https://schoengeometry.com/e-tpms.html>

Complicated exact form (elliptical integrals)

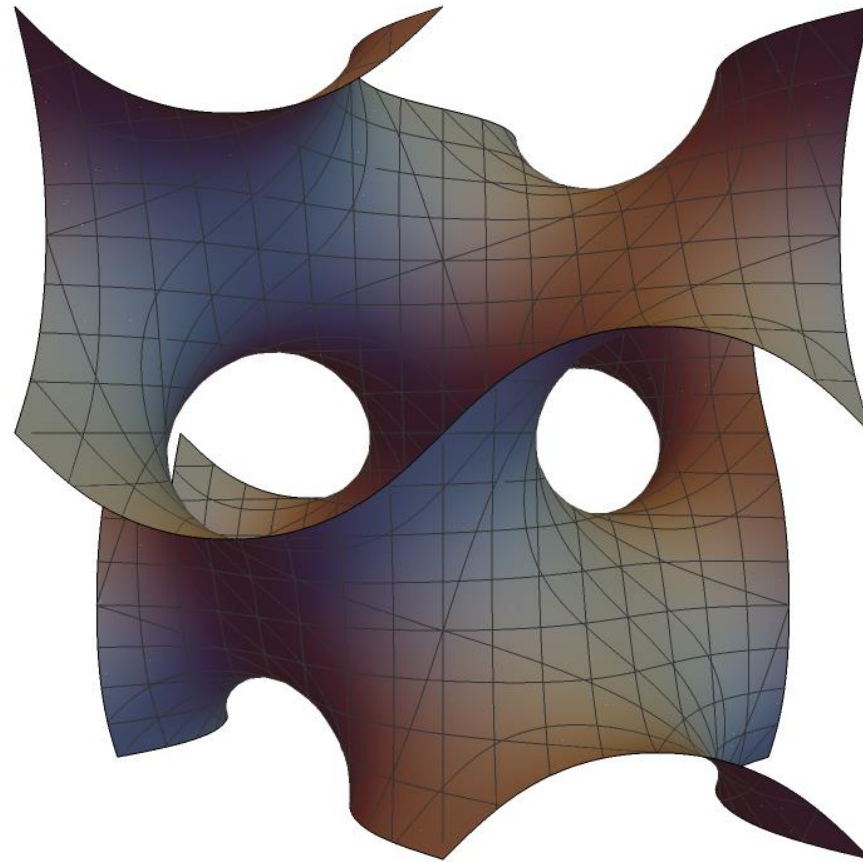
Common concise approximation:

$$\sim \cos(x)\sin(y) + \cos(y)\sin(z) + \cos(z)\sin(x) = 0$$

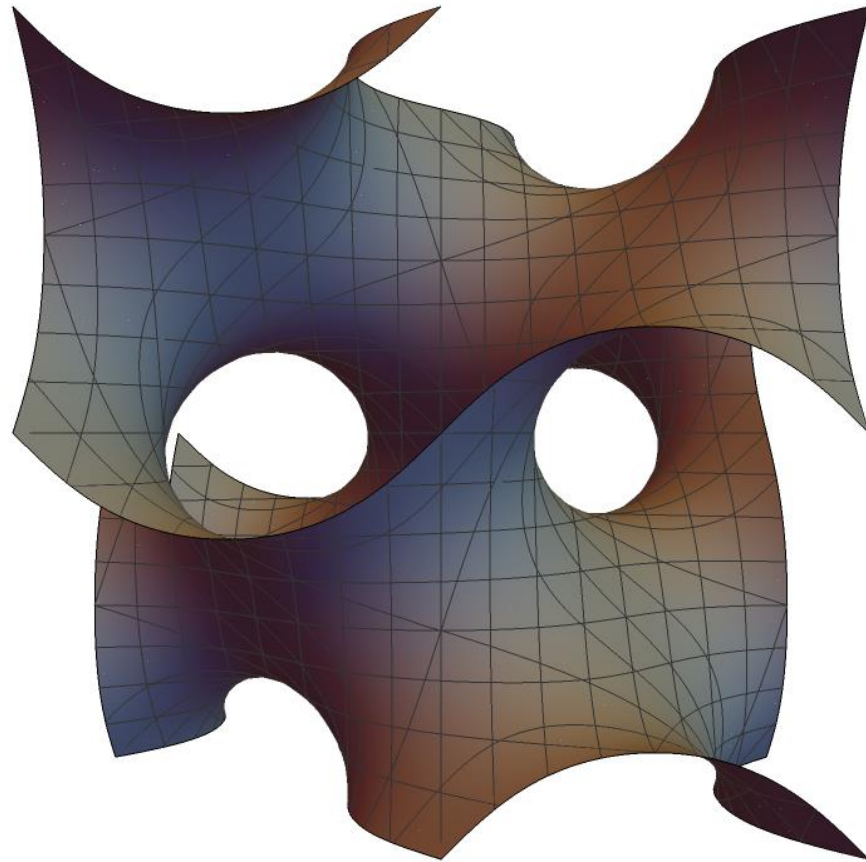


"How would you build a large gyroid?"

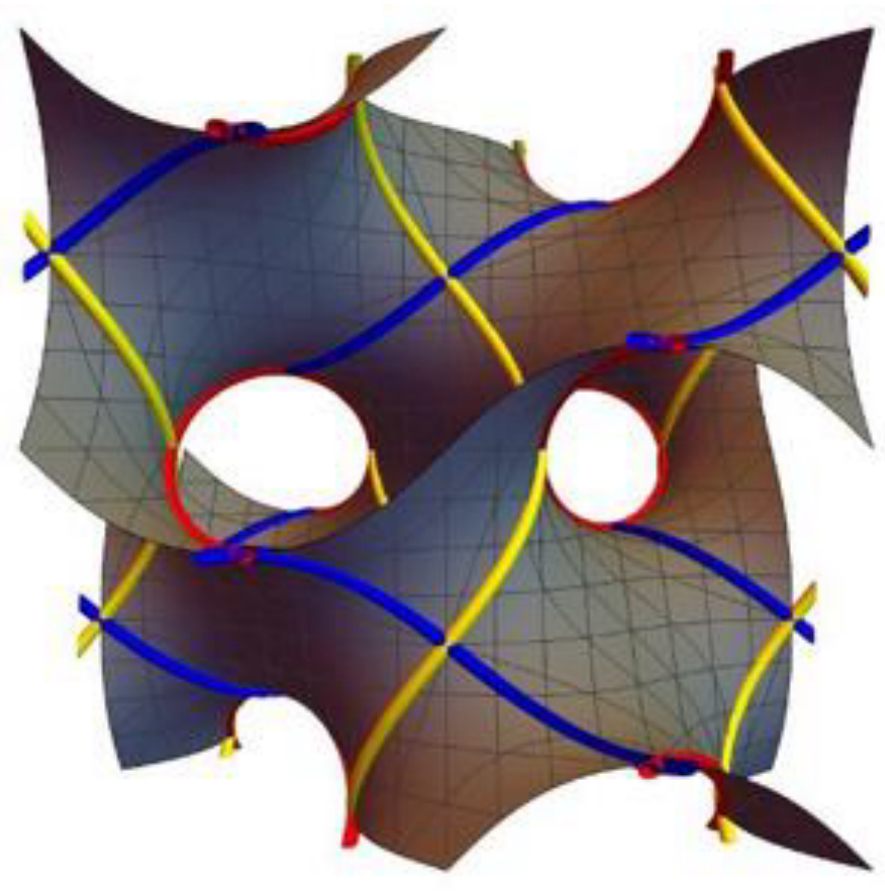
- Prof. K.V. Shajesh, Southern Illinois University - Carbondale



How can I make this complicated thing simpler?



What if I first built its geodesics?

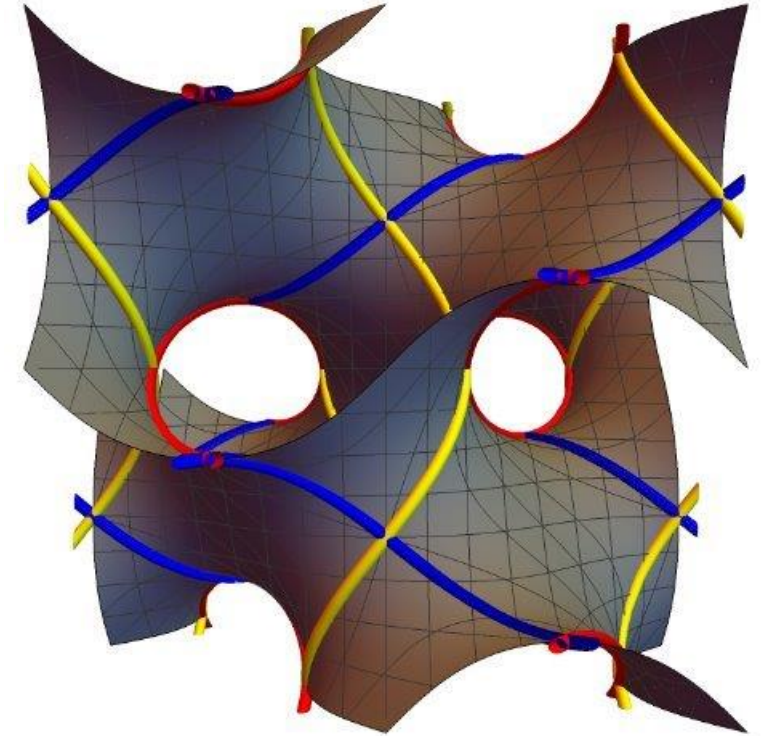
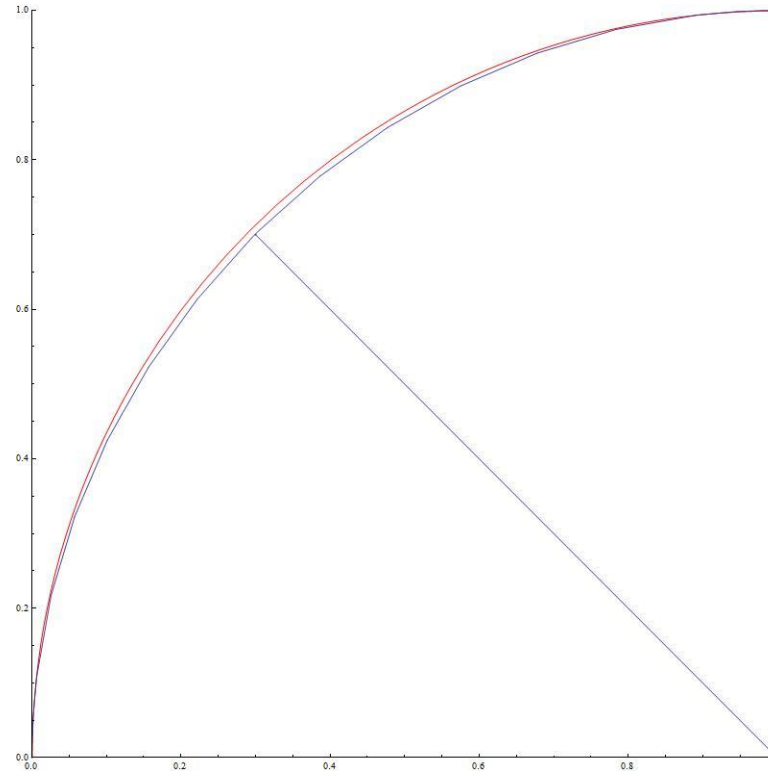
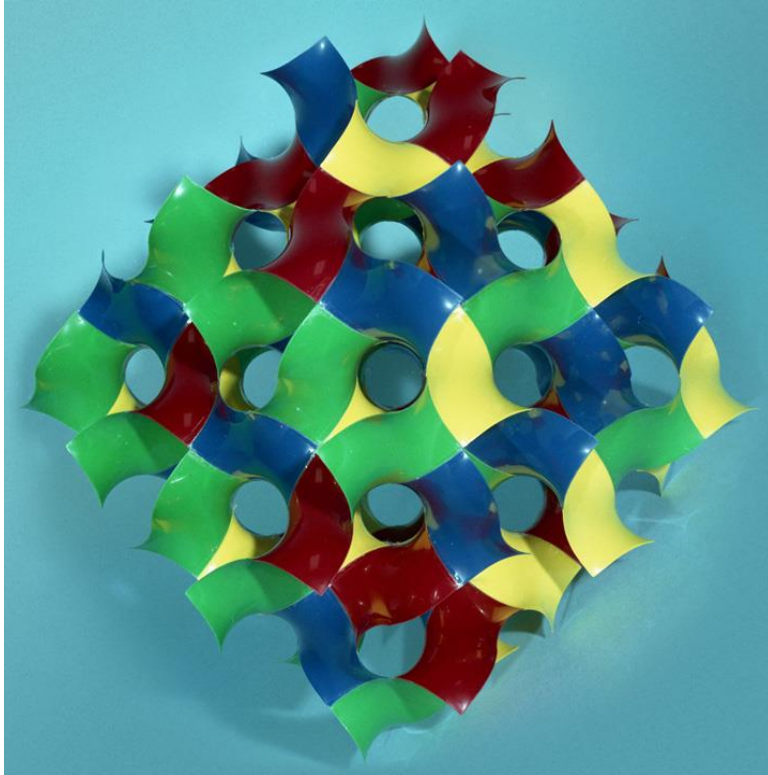


Geodesics

- A geodesic (earth division) is the curve that minimizes the distance between two points on a curved surface.
- Geodesics on a sphere are circles.
 - Great circles
 - Longitude lines (not latitudes)



The Gyroid's Geodesics

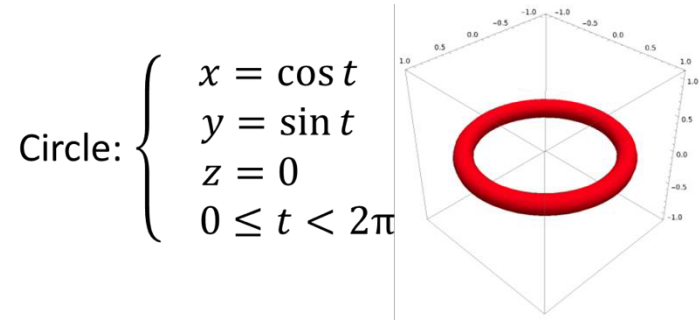


<https://schoengeometry.com/e-tpms.html>

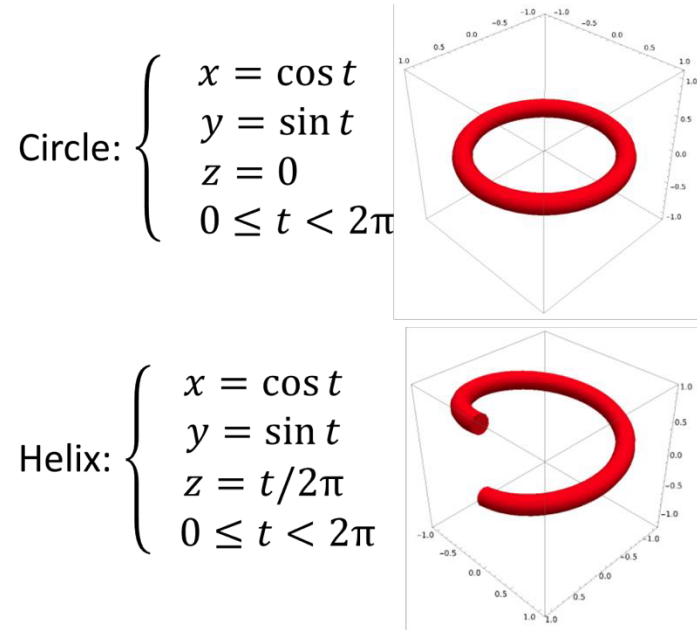
<100> gyroid geodesics are almost helical.
(Perfectly helical with the approximation?)

A brief tangent about sines and cosines...

Defining $\langle 100 \rangle$ Gyroid Geodesics (Mathematics)

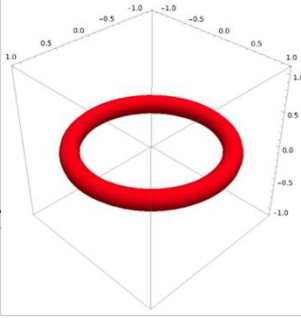


Defining $\langle 100 \rangle$ Gyroid Geodesics (Mathematics)

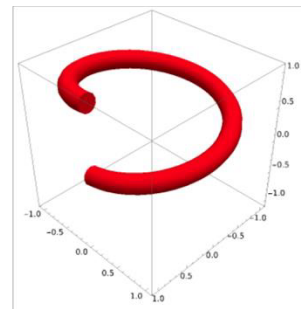


Defining $\langle 100 \rangle$ Gyroid Geodesics (Mathematics)

Circle: $\begin{cases} x = \cos t \\ y = \sin t \\ z = 0 \\ 0 \leq t < 2\pi \end{cases}$



Helix: $\begin{cases} x = \cos t \\ y = \sin t \\ z = t/2\pi \\ 0 \leq t < 2\pi \end{cases}$



Parametric equations for a rotationally symmetric set of three orthogonal helices will be given by:

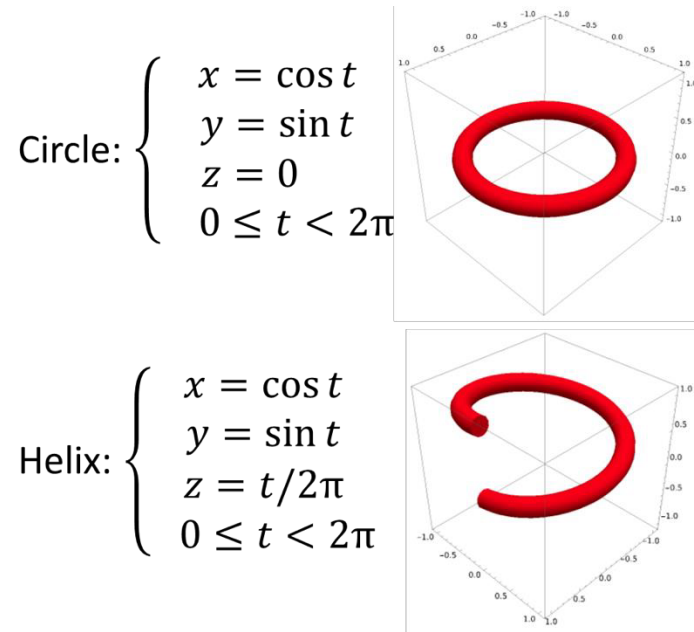
$$H_x(R, \phi, T_i, T_j; t) \equiv [x = \frac{t}{2\pi}, y = R \sin(t + \phi) + T_i, z = R \cos(t + \phi) + T_j]$$

$$H_y(R, \phi, T_i, T_j; t) \equiv [x = R \cos(t + \phi) + T_j, y = \frac{t}{2\pi}, z = R \sin(t + \phi) + T_i]$$

$$H_z(R, \phi, T_i, T_j; t) \equiv [x = R \sin(t + \phi) + T_i, y = R \cos(t + \phi) + T_j, z = \frac{t}{2\pi}]$$

where the index indicates the direction of the axis of each helix, R is the radius, ϕ is a phase, T_i and T_j correspond to translations orthogonal to the axis of rotation, and t is the parameter of the parametric equations.

Defining $\langle 100 \rangle$ Gyroid Geodesics (Mathematics)



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$$H_z(R, \phi, T_i, T_j; t) \equiv [x = R \sin(t + \phi) + T_i, y = R \cos(t + \phi) + T_j, z = \frac{t}{2\pi}]$$

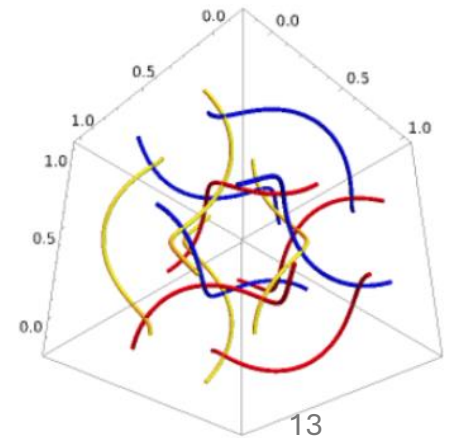
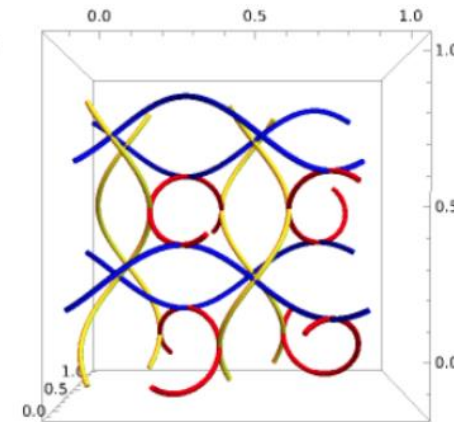
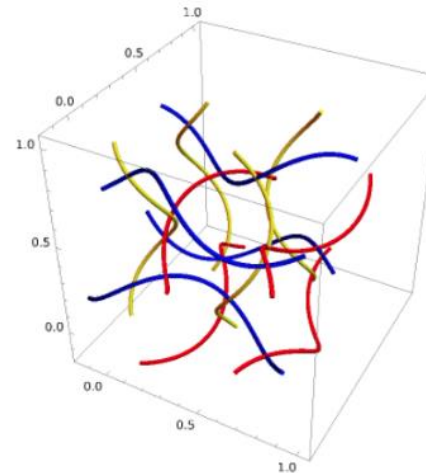
where the index indicates the direction of the axis of each helix, R is the radius, ϕ is a phase, T_i and T_j correspond to translations orthogonal to the axis of rotation, and t is the parameter of the parametric equations.

Approximate $\langle 100 \rangle$ gyroid geodesics (1 unit cell)

$$H_x(\frac{1}{8}, -\frac{\pi}{2}, 0, \frac{1}{4}; t), H_x(\frac{1}{8}, \frac{\pi}{2}, \frac{1}{2}, \frac{3}{4}; t), H_x(-\frac{1}{8}, -\frac{\pi}{2}, 0, \frac{1}{4}; t), H_x(-\frac{1}{8}, \frac{\pi}{2}, \frac{1}{2}, \frac{3}{4}; t)$$

$$H_y(\frac{1}{8}, -\frac{\pi}{2}, 0, \frac{1}{4}; t), H_y(\frac{1}{8}, \frac{\pi}{2}, \frac{1}{2}, \frac{3}{4}; t), H_y(-\frac{1}{8}, -\frac{\pi}{2}, 0, \frac{1}{4}; t), H_y(-\frac{1}{8}, \frac{\pi}{2}, \frac{1}{2}, \frac{3}{4}; t)$$

$$H_z(\frac{1}{8}, -\frac{\pi}{2}, 0, \frac{1}{4}; t), H_z(\frac{1}{8}, \frac{\pi}{2}, \frac{1}{2}, \frac{3}{4}; t), H_z(-\frac{1}{8}, -\frac{\pi}{2}, 0, \frac{1}{4}; t), H_z(-\frac{1}{8}, \frac{\pi}{2}, \frac{1}{2}, \frac{3}{4}; t)$$



Defining $\langle 100 \rangle$ Gyroid Geodesics (Mathematica)

```
d:=0.01
n:=1
ph:=0
rad:=0.125

xhelix[chirality_,ioffset_,joffset_,phase_,radius_,color_,n_]:=ParametricPlot3D[{(t/(2Pi)) ,(radius chirality Sin[t+phase]+ioffset),(radius Cos[t+phase]+joffset)},{t,-Pi/4, 2*n*Pi+Pi/4},PlotStyle->Directive[color,Tube[d]]];
yhelix[chirality_,ioffset_,joffset_,phase_,radius_,color_,n_]:=ParametricPlot3D[{(radius Cos[t+phase]+joffset),(t/(2Pi)) ,(radius chirality Sin[t+phase]+ioffset)},{t,-Pi/4, 2*n*Pi+Pi/4},PlotStyle->Directive[color,Tube[d]]];
zhelix[chirality_,ioffset_,joffset_,phase_,radius_,color_,n_]:=ParametricPlot3D[{(radius chirality Sin[t+phase]+ioffset),(radius Cos[t+phase]+joffset),(t/(2Pi))},{t,-Pi/4, 2*n*Pi+Pi/4},PlotStyle->Directive[color,Tube[d]]];

unitcell[Ti_,Tj_,ph_,n_,rad_,xL1_,xL2_,xR1_,xR2_,yL1_,yL2_,yR1_,yR2_,zL1_,zL2_,zR1_,zR2_] := {

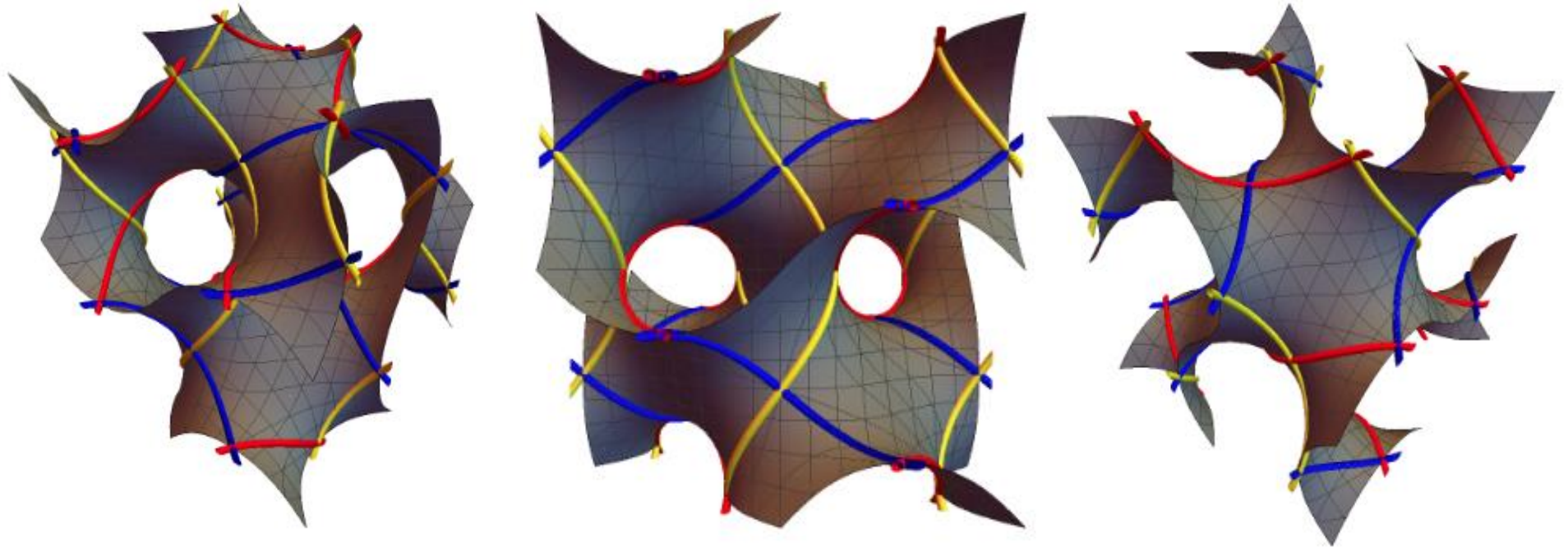
xhelix[1,0+Ti,0.25+Tj,-Pi/2+ph,rad,xL1,n],
yhelix[1,0+Ti,0.25+Tj,-Pi/2+ph,rad,yL1,n],
zhelix[1,0+Ti,0.25+Tj,-Pi/2+ph,rad,zL1,n],

xhelix[1,0.5+Ti,0.75+Tj,Pi/2+ph,rad,xL2,n],
yhelix[1,0.5+Ti,0.75+Tj,Pi/2+ph,rad,yL2,n],
zhelix[1,0.5+Ti,0.75+Tj,Pi/2+ph,rad,zL2,n],

xhelix[-1,0+Ti,0.75+Tj,-Pi/2+ph,rad,xR1,n],
yhelix[-1,0+Ti,0.75+Tj,-Pi/2+ph,rad,yR1,n],
zhelix[-1,0+Ti,0.75+Tj,-Pi/2+ph,rad,zR1,n],

xhelix[-1,0.5+Ti,0.25+Tj,Pi/2+ph,rad,xR2,n],
yhelix[-1,0.5+Ti,0.25+Tj,Pi/2+ph,rad,yR2,n],
zhelix[-1,0.5+Ti,0.25+Tj,Pi/2+ph,rad,zR2,n]];

xL1:= Blue
xL2:= Blue
yL1:= Red
yL2:= Red
zL1:= Yellow
zL2:=Yellow
xR1:=Blue
xR2:=Blue
yR1:=Red
yR2:=Red
zR1:= Yellow
zR2:=Yellow
Show[
ContourPlot3D[Cos[2Pi x]Sin[2Pi y]+Cos[2Pi y]Sin[2Pi z]+Cos[2Pi z]Sin[2Pi x]\[Equal]0,{x,0,1},{y,0,1},{z,0,1},ContourStyle->Directive[Gray,Opacity[1]]],
ParametricPlot3D[{t,0,0},{0,t,0},{0,0,t}},{t,-0.15,n+0.15},PlotStyle->RGBColor[Transparent]],
Table[unitcell[Ti,Tj,ph,n,rad,xL1,xL2,xR1,xR2,yL1,yL2,yR1,yR2,zL1,zL2,zR1,zR2},{Ti,0,n-1},{Tj,0,n-1}],Background->White,Boxed->False,ViewPoint->Front,Axes->False]
```



<https://community.wolfram.com/groups/-/m/t/3126212>

Defining $\langle 100 \rangle$ Gyroid Geodesics (Mathematica)

d:=0.01

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```
xhelix[chirality_,ioffset_,joffset_,phase_,radius_,color_,n_]:=ParametricPlot3D[{(t/(2Pi)),(radius chirality Sin[t+phase]+ioffset),(radius Cos[t+phase]+joffset)},{t,-Pi/4, 2*n*Pi+Pi/4},PlotStyle->Directive[color,Tube[d]]];
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zhelix[chirality_,ioffset_,joffset_,phase_,radius_,color_,n_]:=ParametricPlot3D[{(radius chirality Sin[t+phase]+ioffset),(radius Cos[t+phase]+joffset),(t/(2Pi))},{t,-Pi/4, 2*n*Pi+Pi/4},PlotStyle->Directive[color,Tube[d]]];
```

```
unitcell[Ti_,Tj_,ph_,n_,rad_,xL1_,xL2_,xR1_,xR2_,yL1_,yL2_,yR1_,yR2_,zL1_,zL2_,zR1_,zR2_] := {
```

```
xhelix[1,0+Ti,0.25+Tj,-Pi/2+ph,rad,xL1,n],
yhelix[1,0+Ti,0.25+Tj,-Pi/2+ph,rad,yL1,n],
zhelix[1,0+Ti,0.25+Tj,-Pi/2+ph,rad,zL1,n],
```

```
xhelix[1,0.5+Ti,0.75+Tj,Pi/2+ph,rad,xL2,n],
yhelix[1,0.5+Ti,0.75+Tj,Pi/2+ph,rad,yL2,n],
zhelix[1,0.5+Ti,0.75+Tj,Pi/2+ph,rad,zL2,n],
```

```
xhelix[-1,0+Ti,0.75+Tj,-Pi/2+ph,rad,xR1,n],
yhelix[-1,0+Ti,0.75+Tj,-Pi/2+ph,rad,yR1,n],
zhelix[-1,0+Ti,0.75+Tj,-Pi/2+ph,rad,zR1,n],
```

```
xhelix[-1,0.5+Ti,0.25+Tj,Pi/2+ph,rad,xR2,n],
yhelix[-1,0.5+Ti,0.25+Tj,Pi/2+ph,rad,yR2,n],
zhelix[-1,0.5+Ti,0.25+Tj,Pi/2+ph,rad,zR2,n];
```

xL1:= Blue

xL2:= Blue

yL1:= Red

yL2:= Red

zL1:= Yellow

zL2:=Yellow

xR1:=Blue

xR2:=Blue

yR1:=Red

yR2:=Red

zR1:= Yellow

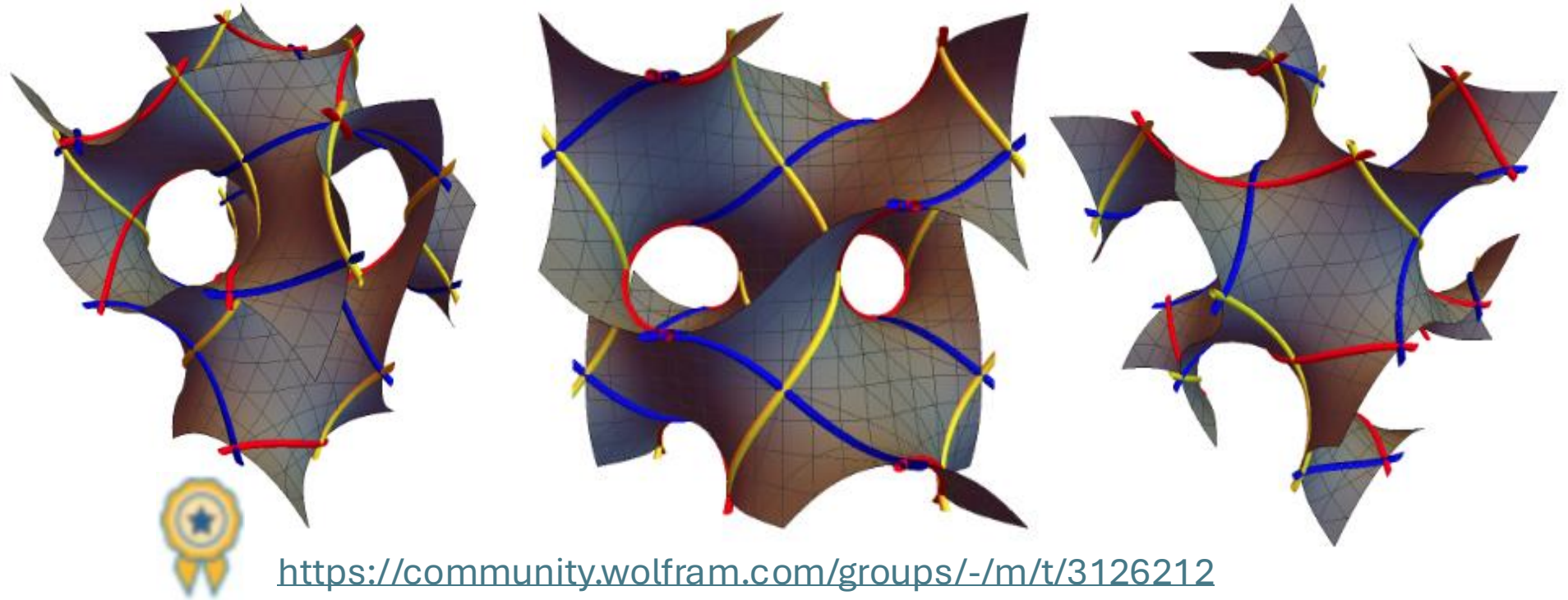
zR2:=Yellow

Show[

```
ContourPlot3D[Cos[2Pi x]Sin[2Pi y]+Cos[2Pi y]Sin[2Pi z]+Cos[2Pi z]Sin[2Pi x]\[Equal]0,{x,0,1},{y,0,1},{z,0,1},ContourStyle->Directive[Gray,Opacity[1]]],
```

```
ParametricPlot3D[{t,0,0},{0,t,0},{0,0,t},{t,-0.15,n+0.15},PlotStyle->RGBColor[Transparent]],
```

```
Table[unitcell[Ti,Tj,ph,n,rad,xL1,xL2,xR1,xR2,yL1,yL2,yR1,yR2,zL1,zL2,zR1,zR2},{Ti,0,n-1},{Tj,0,n-1}],Background->White,Boxed->False,ViewPoint->Front,Axes->False]
```



<https://community.wolfram.com/groups/-/m/t/3126212>

Setting out to model approximate gyroid geodesics

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Step 1: Make helices

- wind wire (or metal strips) around rod
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- sticky tack (no)
- zip-ties (no)
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- **weaving (Eureka moment! – September 2019)**
 - My first real weave was chiral and completely accidental.
($\langle 100 \rangle$ trefoil Laves weave aka “wiroid”)
(rotation and expansion of approx. $\langle 100 \rangle$ gyroid geodesics)
 - follows Laves graph or (10,3)-a network

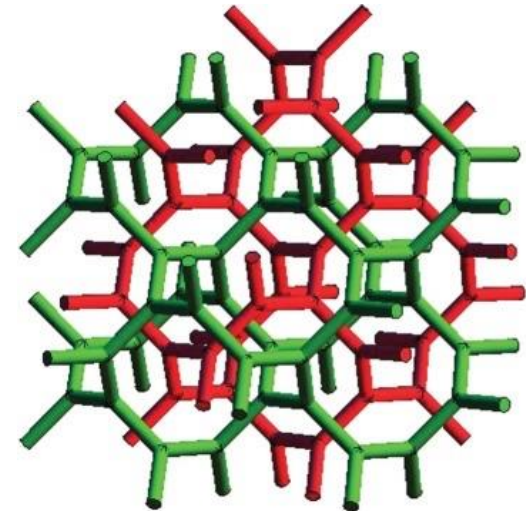
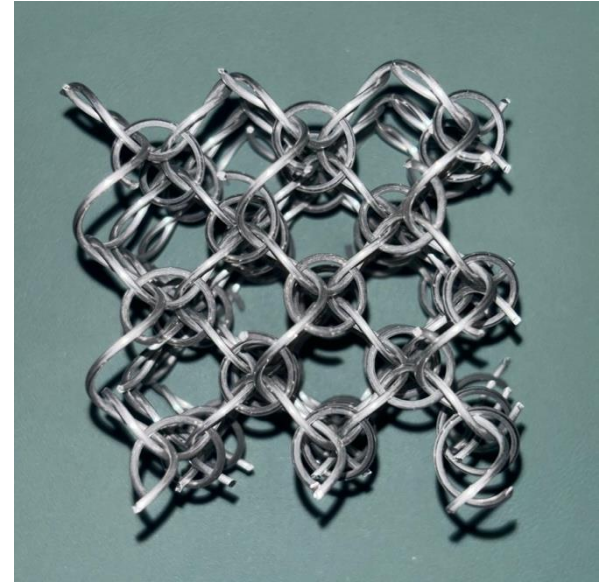
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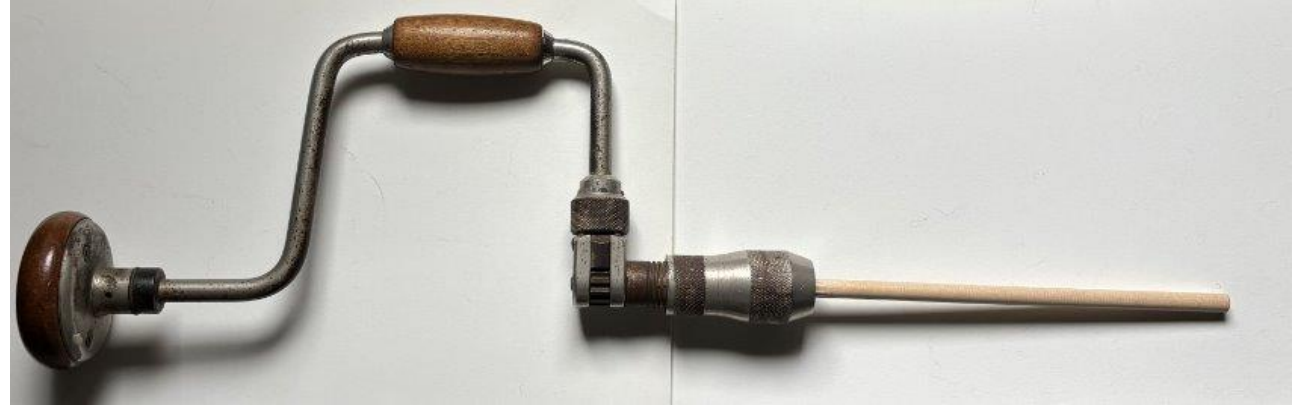
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“Laves graph” or “(10,3)-a”²⁰

My method for creating metal helices

Step 1: Wrap wire around a rod.



My method for creating metal helices

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My method for creating metal helices

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Step 2: Stretch the resulting helix to the correct pitch.



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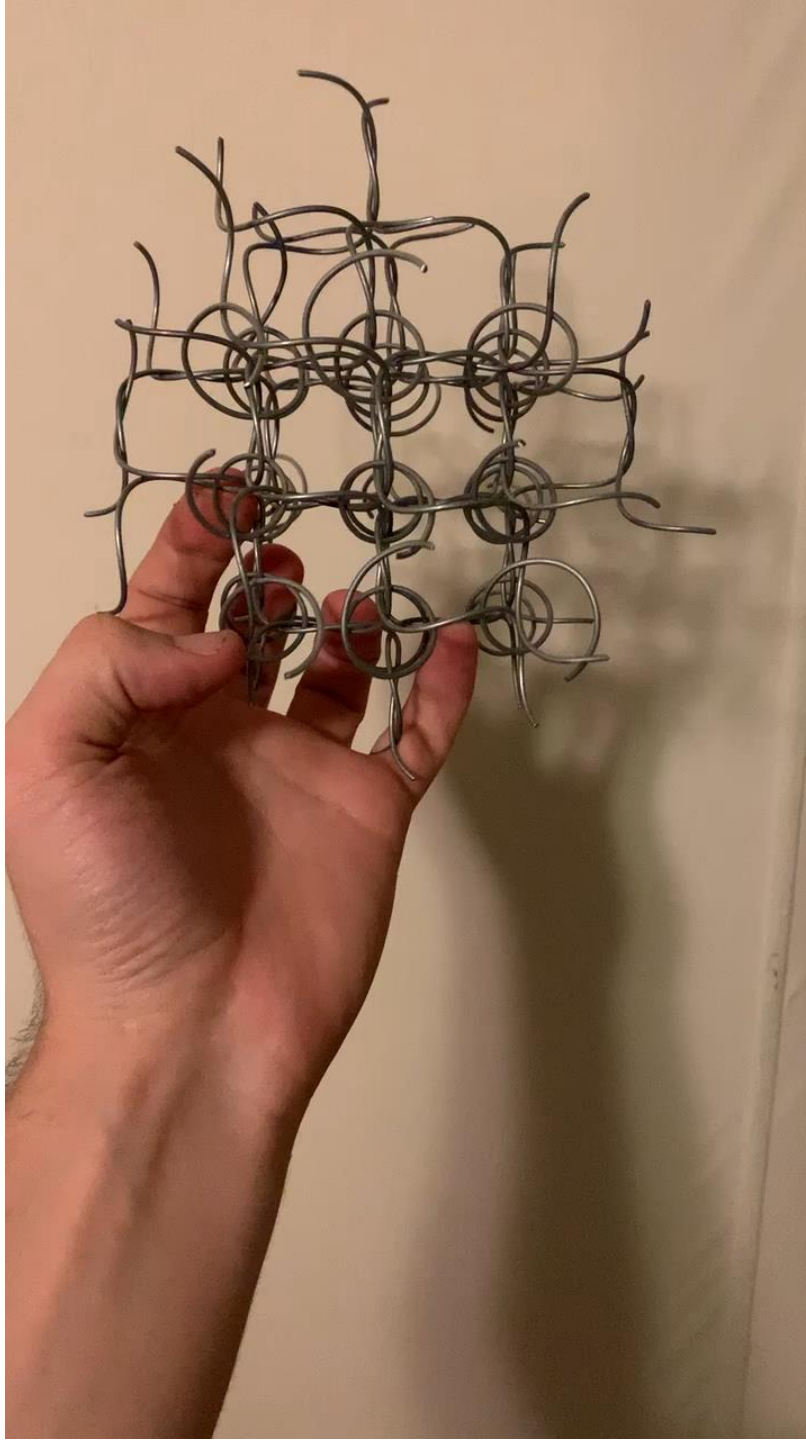
Step 2: Stretch the resulting helix to the correct pitch.

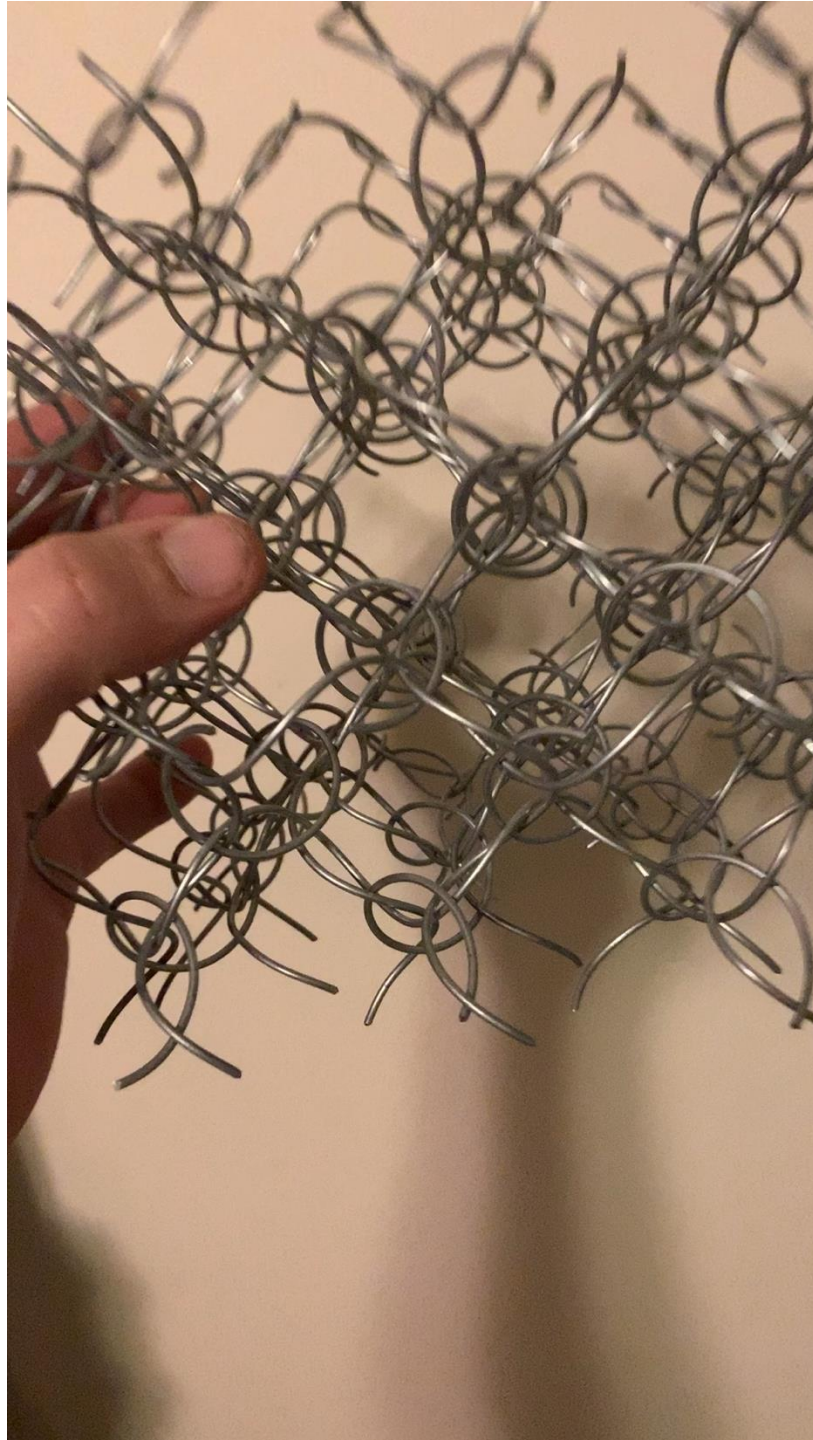


Step 3: Cut this long helix into pieces.

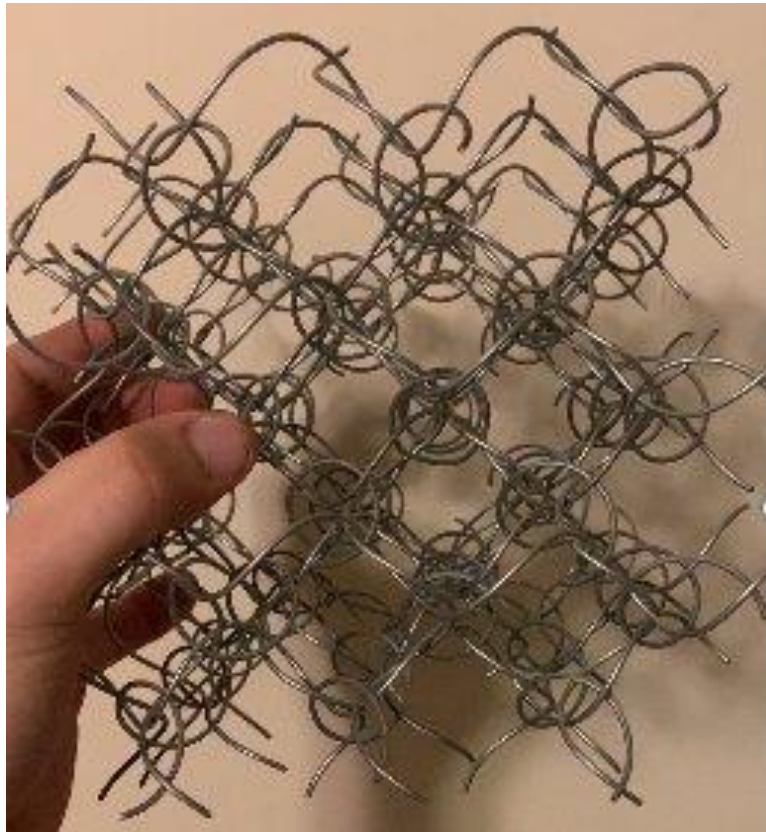




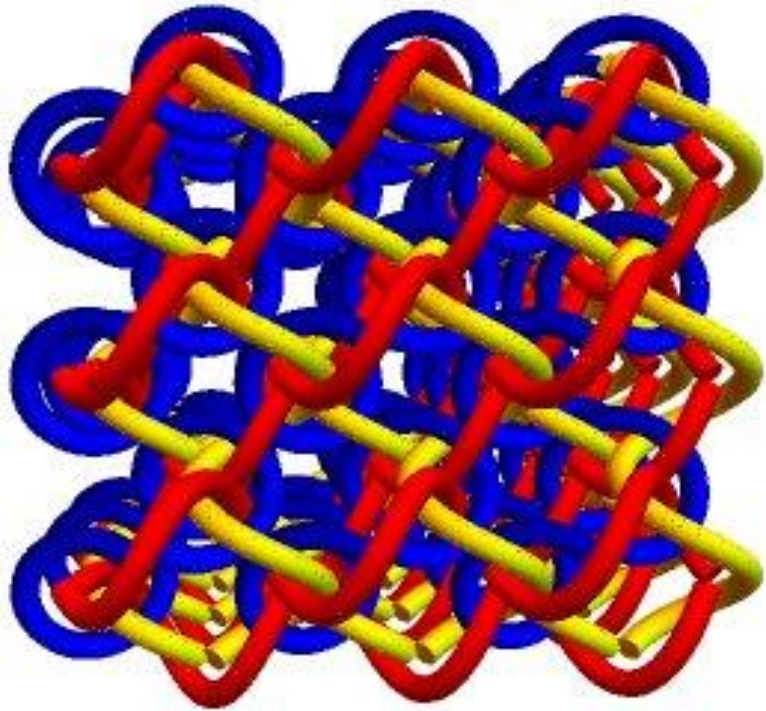




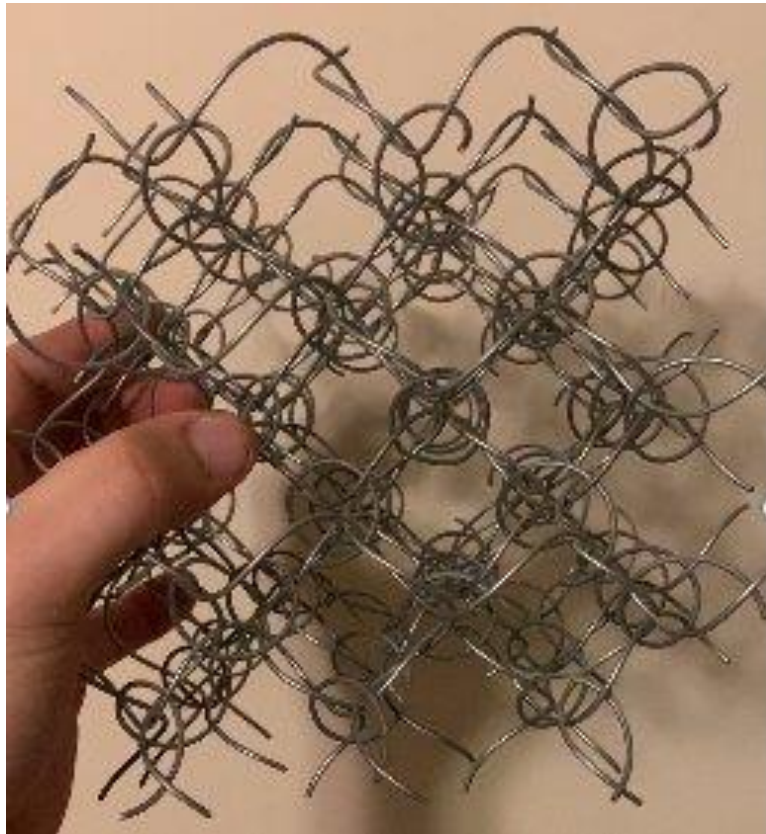
What had I done? This isn't a gyroid... or is it?



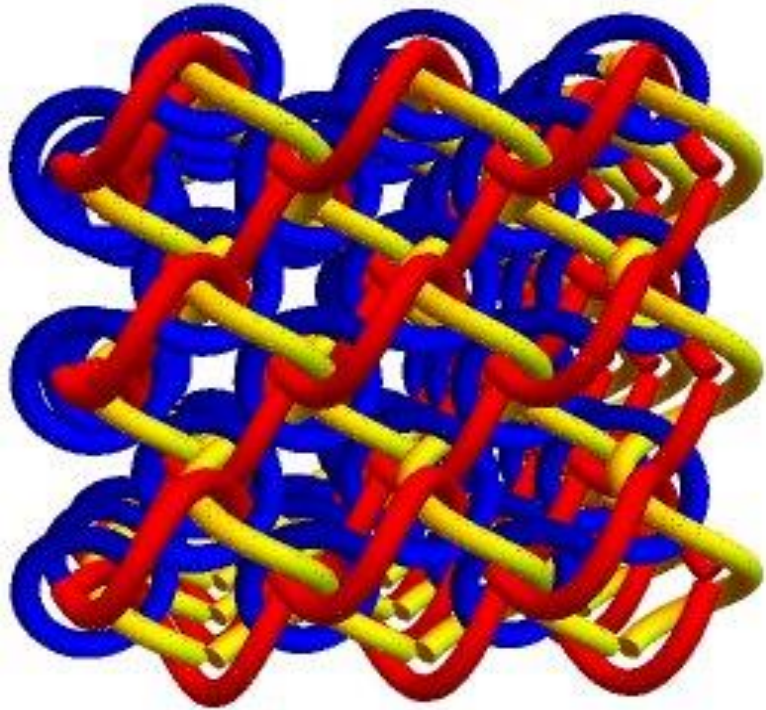
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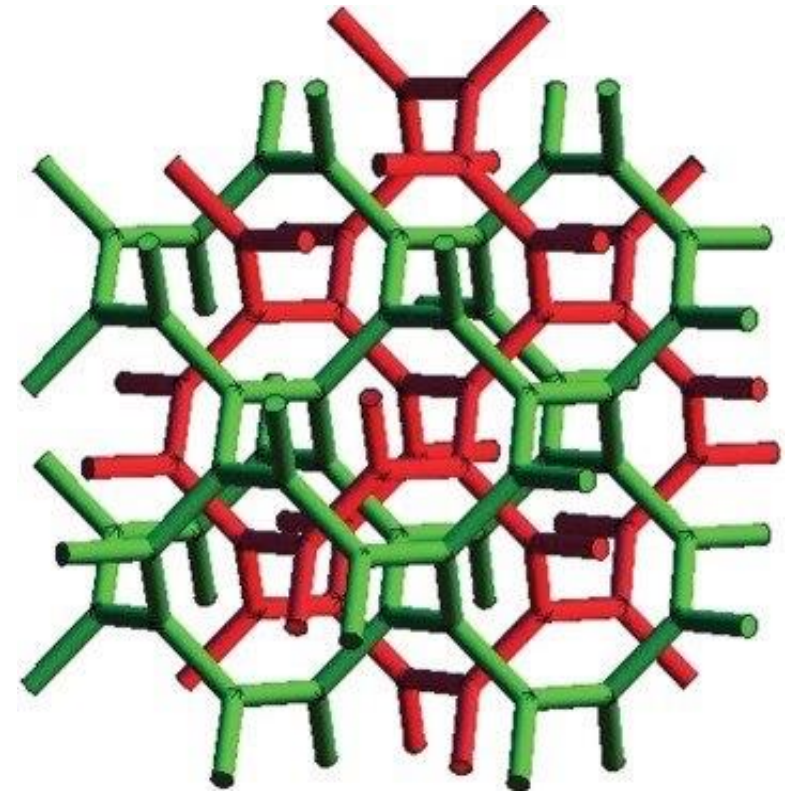
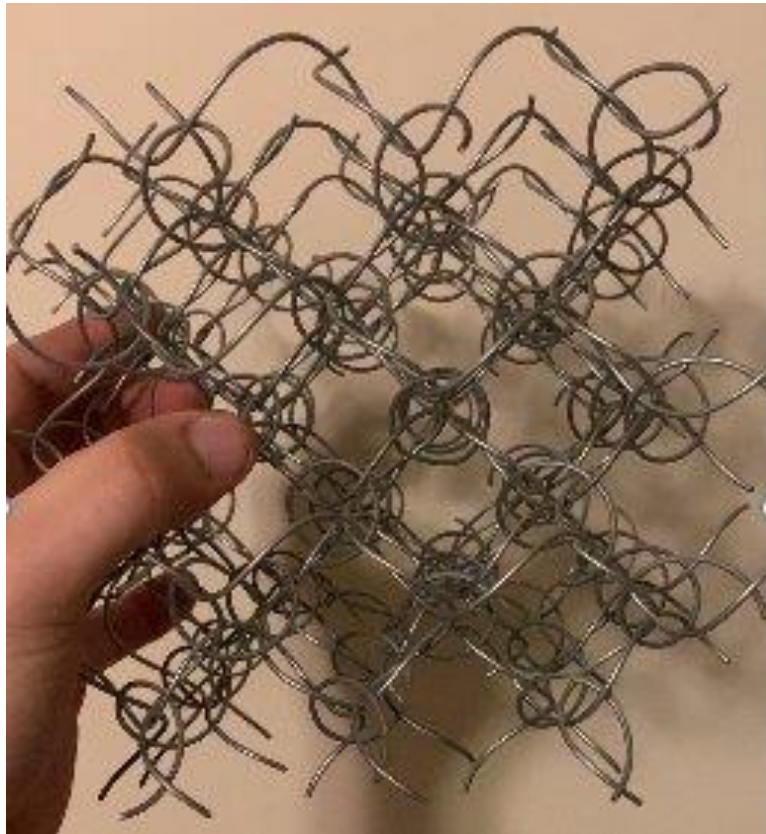
<https://community.wolfram.com/t/triply-periodic-helical-weaves/23617>

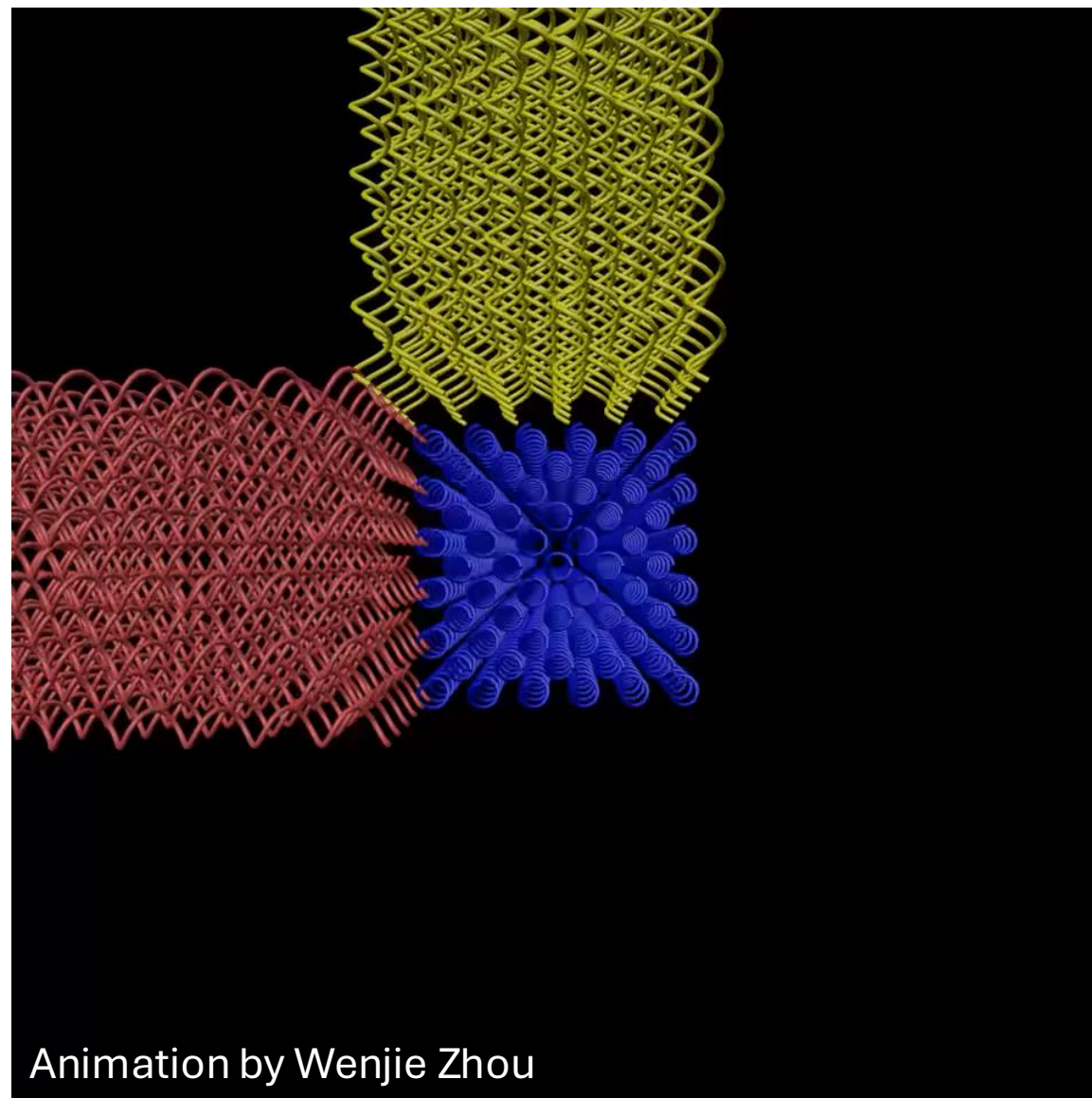


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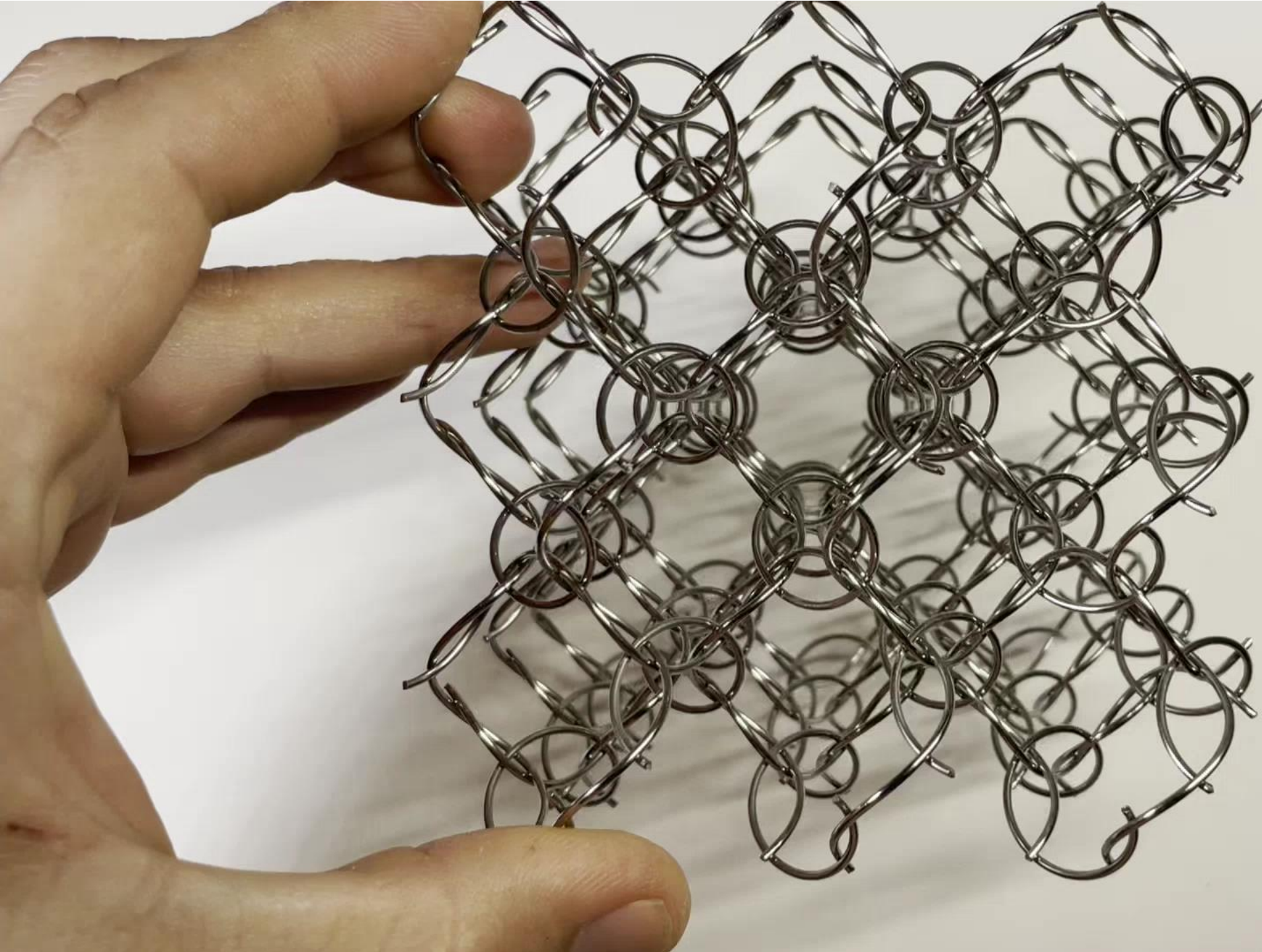


<https://community.wolfram.com/t/triply-periodic-helical-weaves/23617>

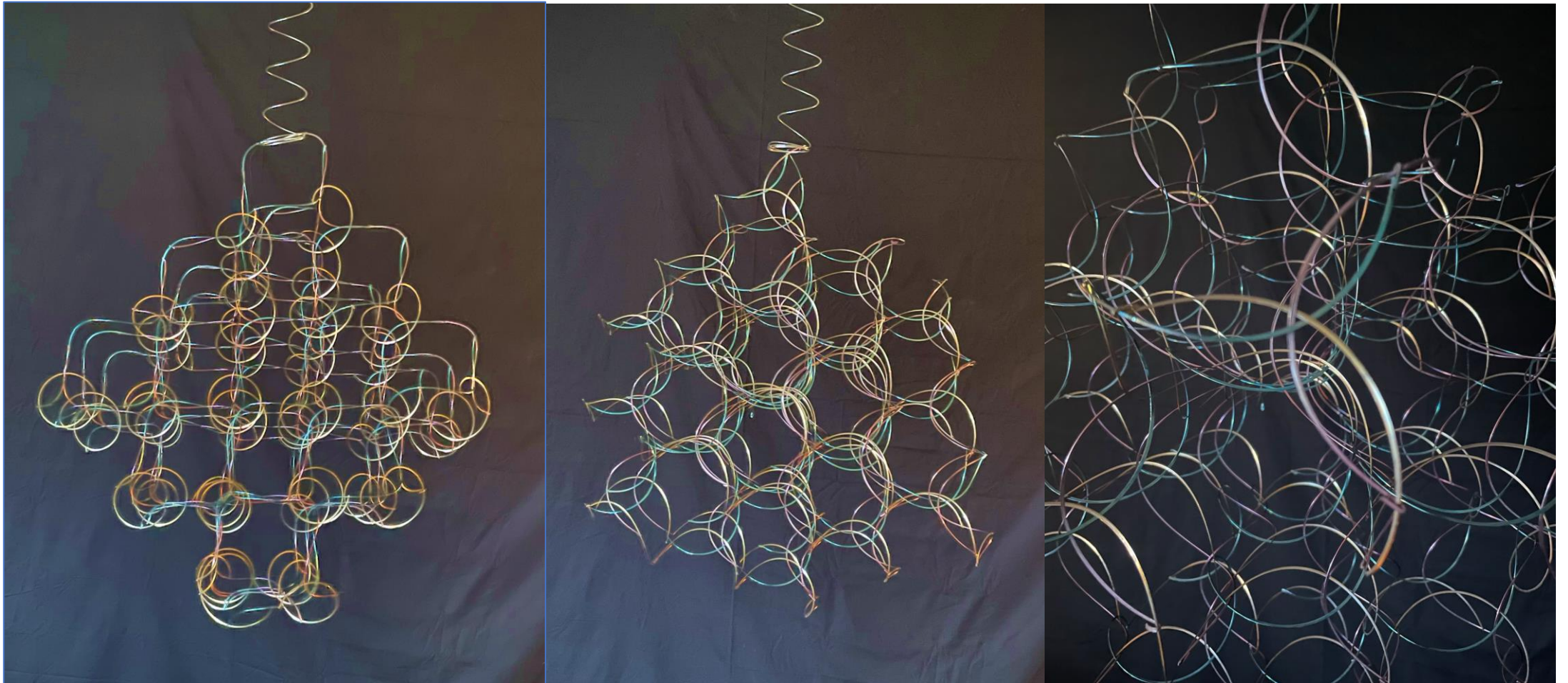




Animation by Wenjie Zhou



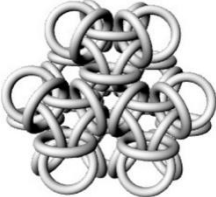
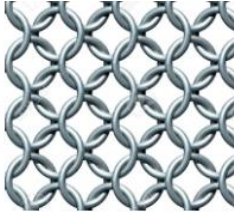
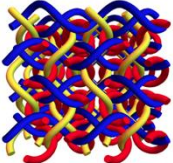
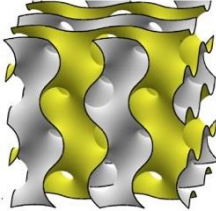
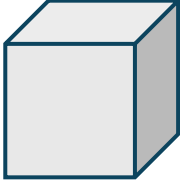
"Minimally Entwined"



A table of periodic elements...

Periodic Materials

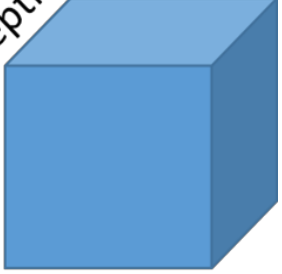
(materials composed of periodic elements of lower effective dimension)

		Material Dimension			
		3D	2D	1D	0D
Element Dimension	0D	Triply Periodic Links 	Chainmail 	Chain 	Ring* (Point) 
	1D	Wire-woven Cellular Metals Triply Periodic Weaves (Sinusoidal or Helical) 	Chain-link Fence Fabric, Moorish Fretwork 	Wire, Thread (Line) 	*A ring is technically a closed 1-manifold.
	2D	Book, Origami, Triply Periodic Minimal Surfaces (single element) 	Paper (Plane) 		
	3D	Bulk Material (Volume) 			


 $D = 0$


 $D = 1$


 $D = 2$


 $D = 3$

Triply Periodic Helical Weaves

Duston Wetzel¹, Paul Gailiunas², Moses Gaither-Ganim³, and William Holt⁴

¹Southern Illinois University - Carbondale, Carbondale, IL, USA; dustonwetzel@live.com

²Newcastle, UK; paulgailiunas@yahoo.co.uk

³St. Louis, MO, USA; mgaitherg@gmail.com

⁴Indiana University - Bloomington, Bloomington, IN, USA; willholt@iu.edu

Abstract

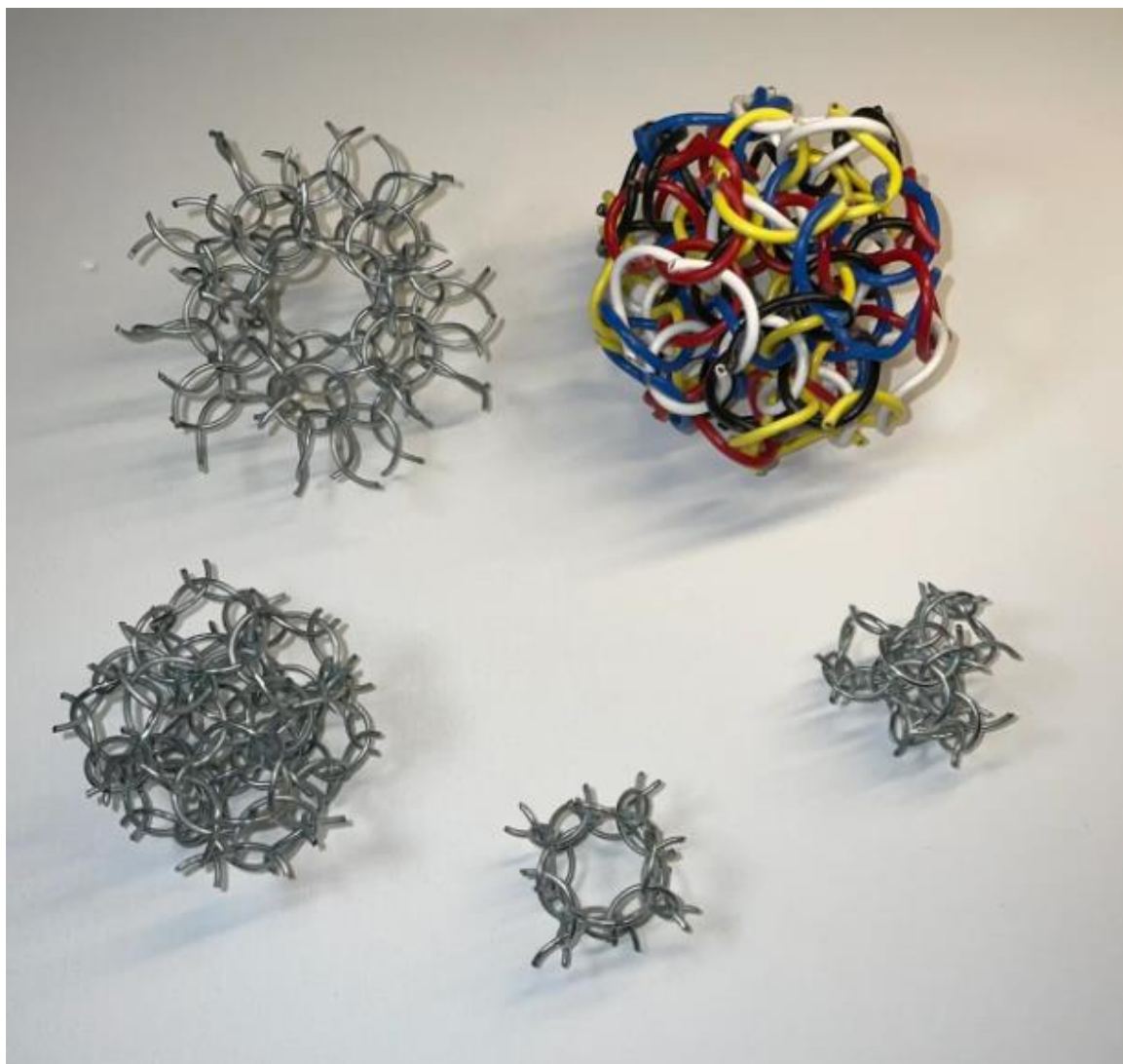
Weaving typically involves forming a surface by interlacing fibers into a mechanically stable arrangement, effectively making a two-dimensional object out of one-dimensional objects. Moorish Fretwork involves interweaving solid helical elements into mechanically stable two-dimensional arrangements by exploiting the helices' screw symmetry. A three-dimensional extension of this idea was demonstrated by Alexandru Usineviciu at Bridges in 2015 [15]. Here we expand the idea further by considering cases informed by invariant cylindrical rod packing, and discuss interweaving geodesics of the gyroid. Simulations and/or physical models of nineteen triply periodic arrangements of interwoven helices are shown, with physical models demonstrated for eight.



<https://archive.bridgesmathart.org/2024/bridges2024-267.pdf>



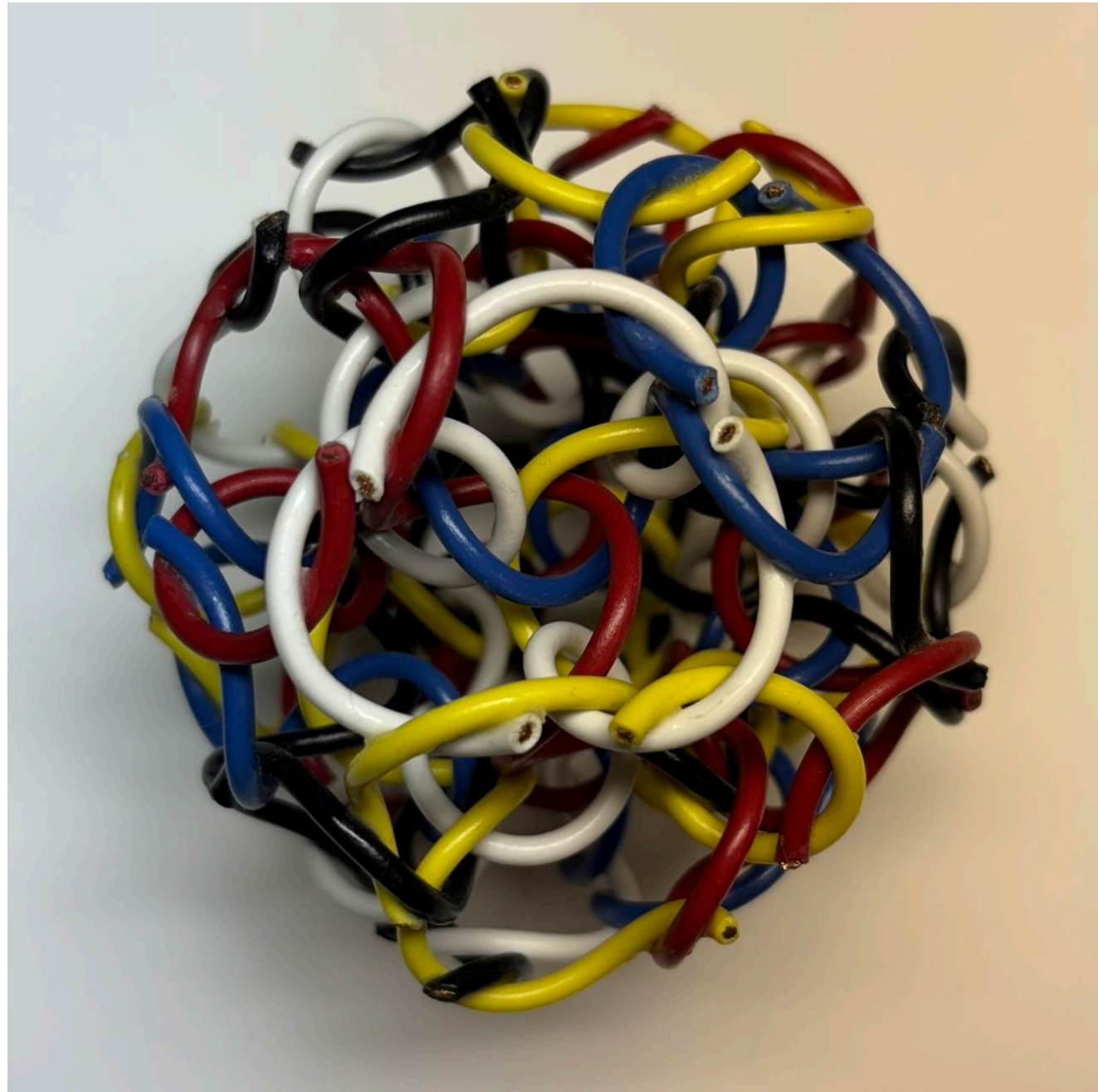
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<https://gallery.bridgesmathart.org/exhibitions/bridges-2024-exhibition-of-mathematical-art/duston-wetzel>



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For lack of better made-up words...

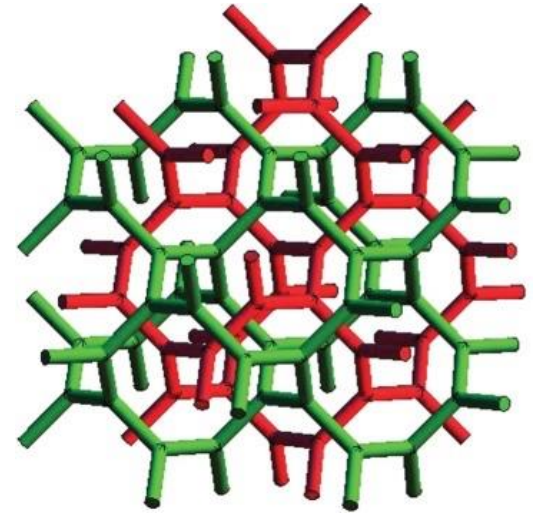
Nomenclature

Axis Directions (Miller) + Crossing Type + Lattice Type

$\langle 100 \rangle$ = up one, not back one or over one = edge

$\langle 110 \rangle$ = up one, back one, not over one = face diagonal

$\langle 111 \rangle$ = up one, back one, over one = body diagonal



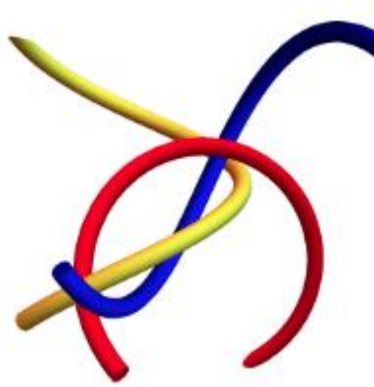
Laves Graph or (10,3)-a



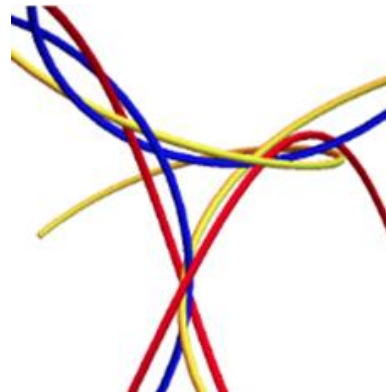
Trigonal



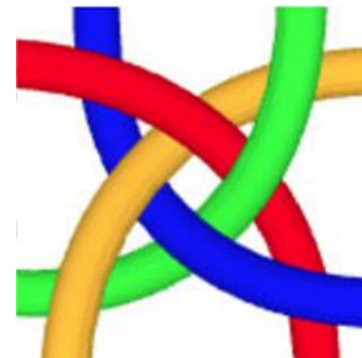
Trefoil



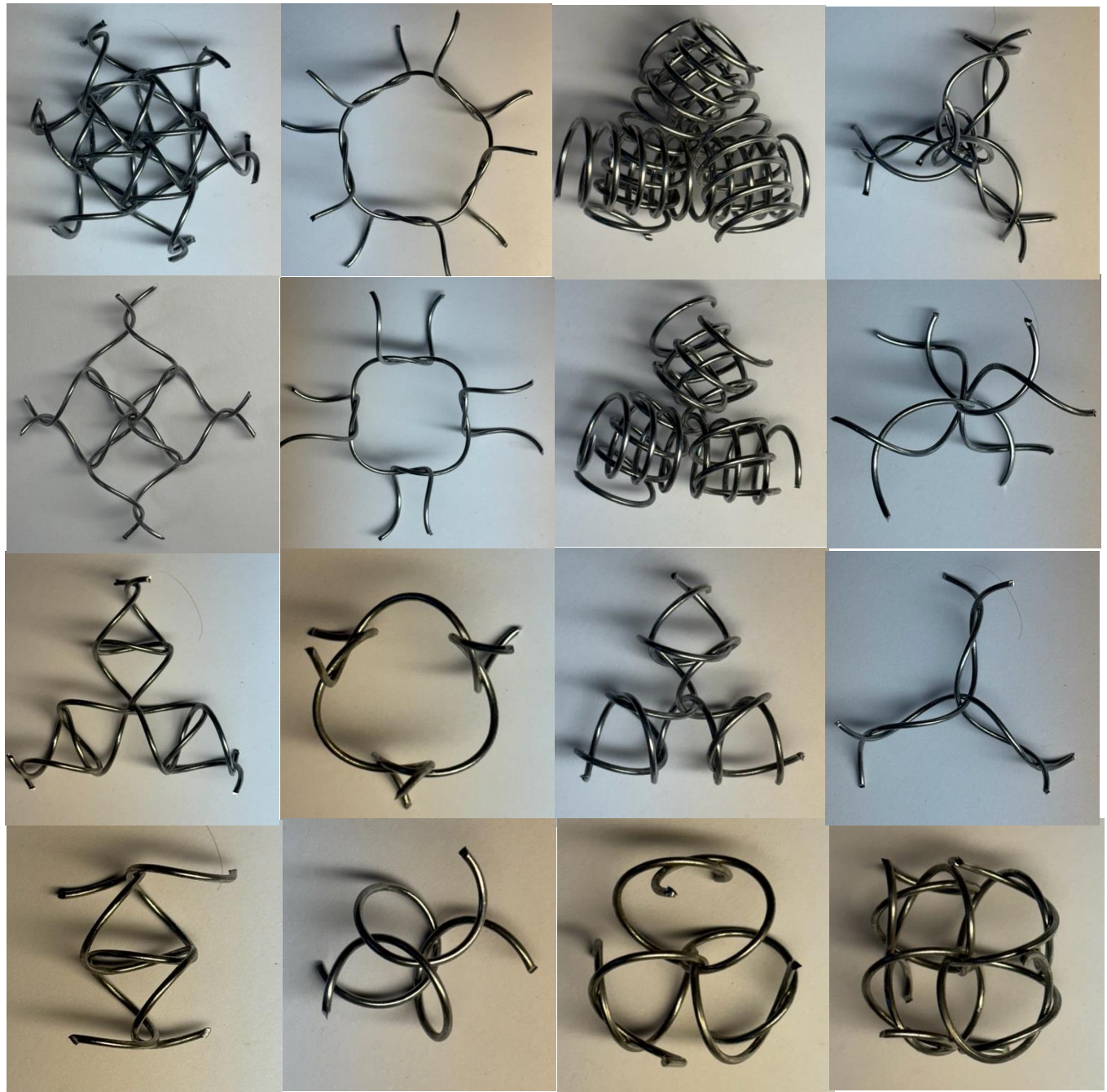
Trio



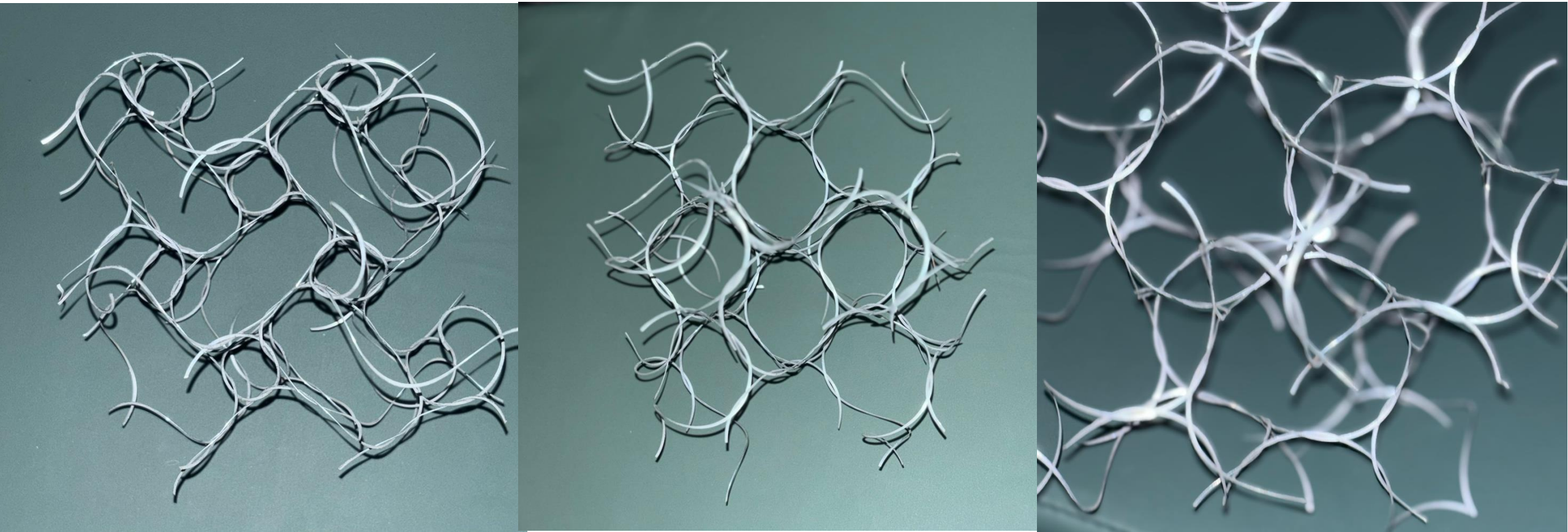
Braid



Quatrefoil

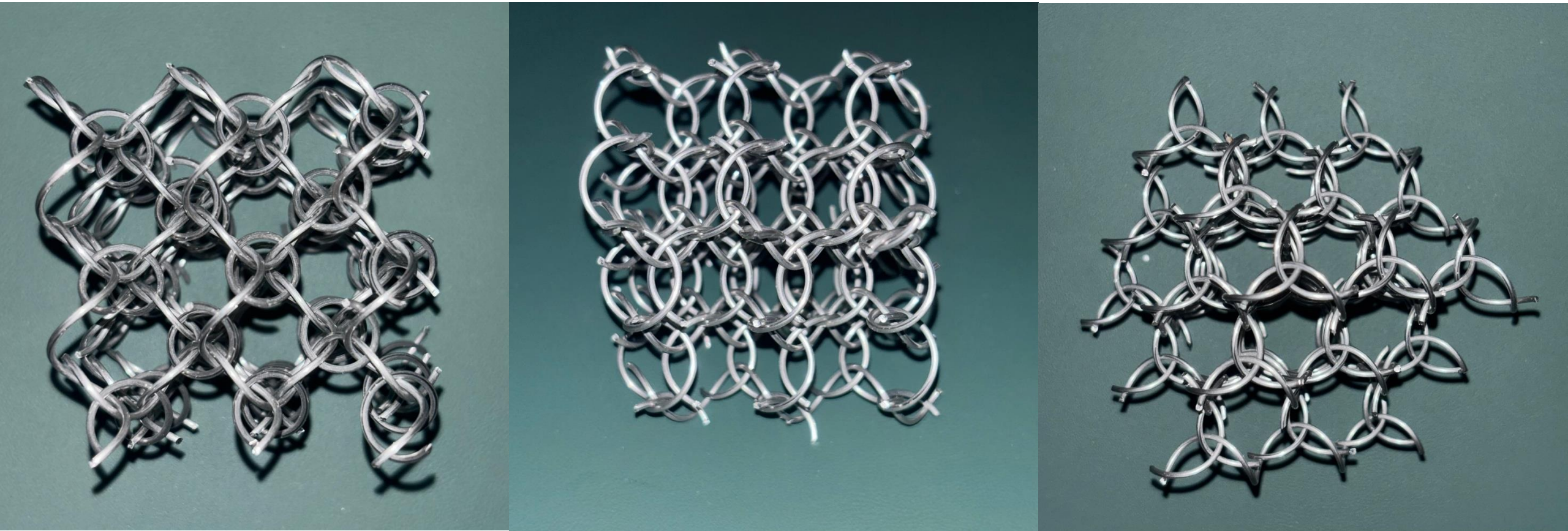


<100> Trigonal Laves



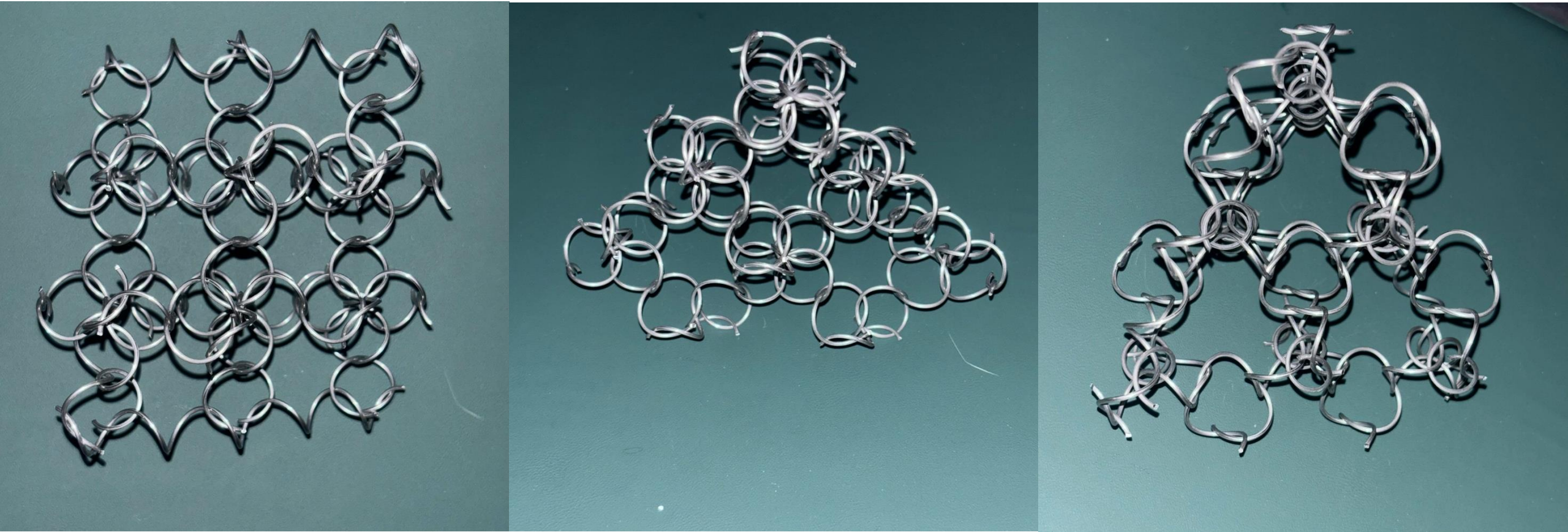
Discovered by Duston Wetzel: 2023

<100> Trefoil Laves (aka "wiroid")



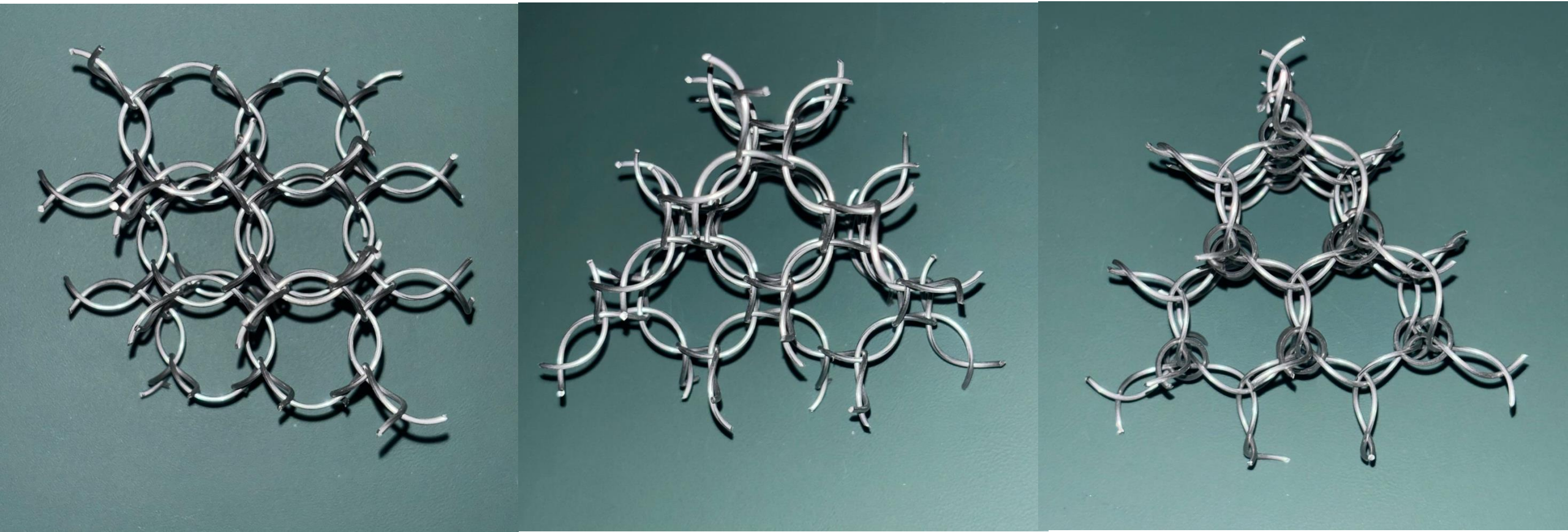
Discovered by Duston Wetzel: 2019

<111> Annular Laves



Discovered by Duston Wetzel: 2025

<111> Trefoil Laves



Discovered by Paul Gailiunas 2023

<111> Double-Link Laves



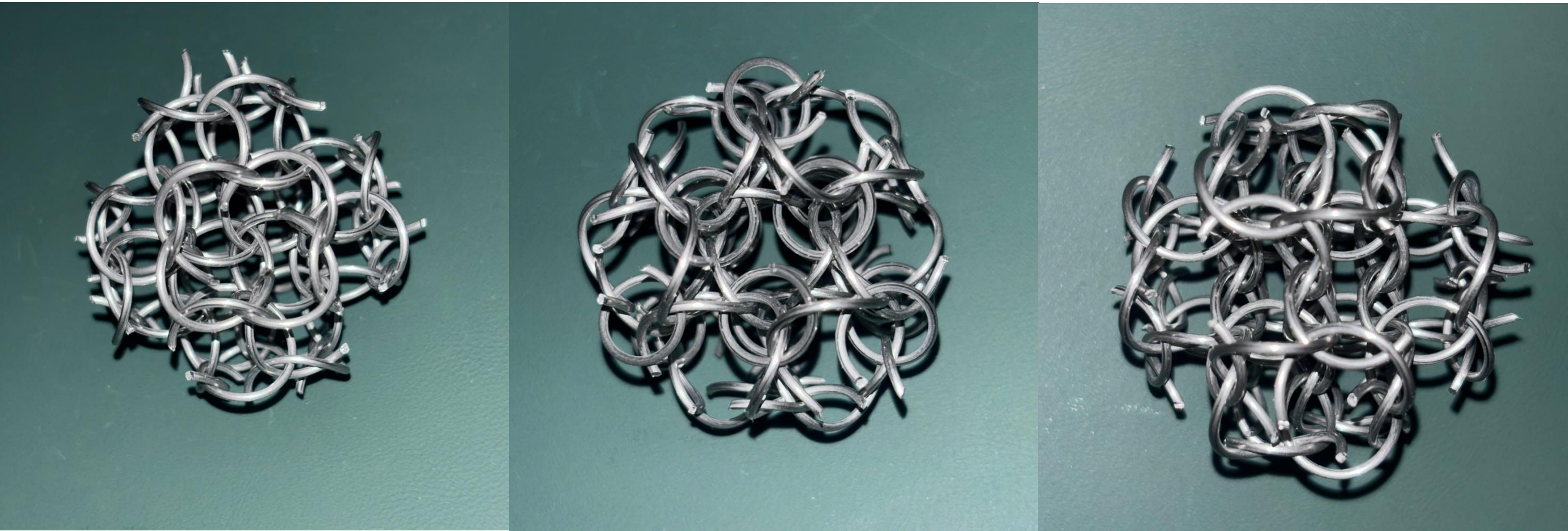
Discovered by Duston Wetzel: 2024

<111> Triple-Link Laves



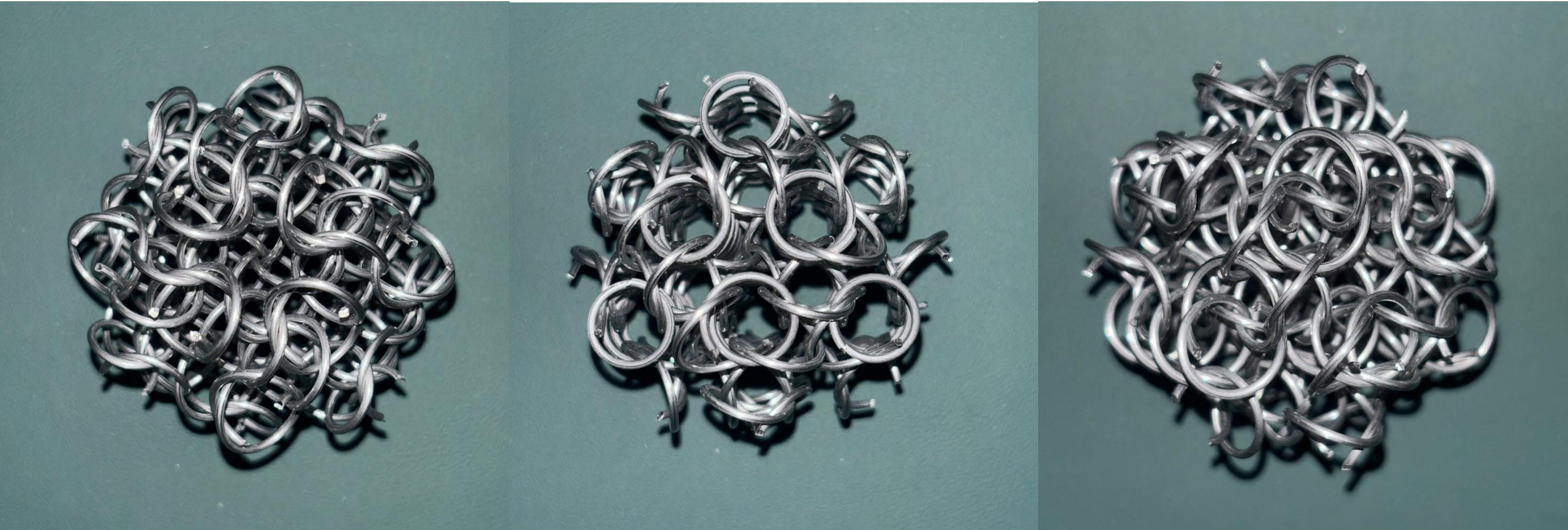
Discovered by Duston Wetzel: 2025

<111> Quatrefoil Omega



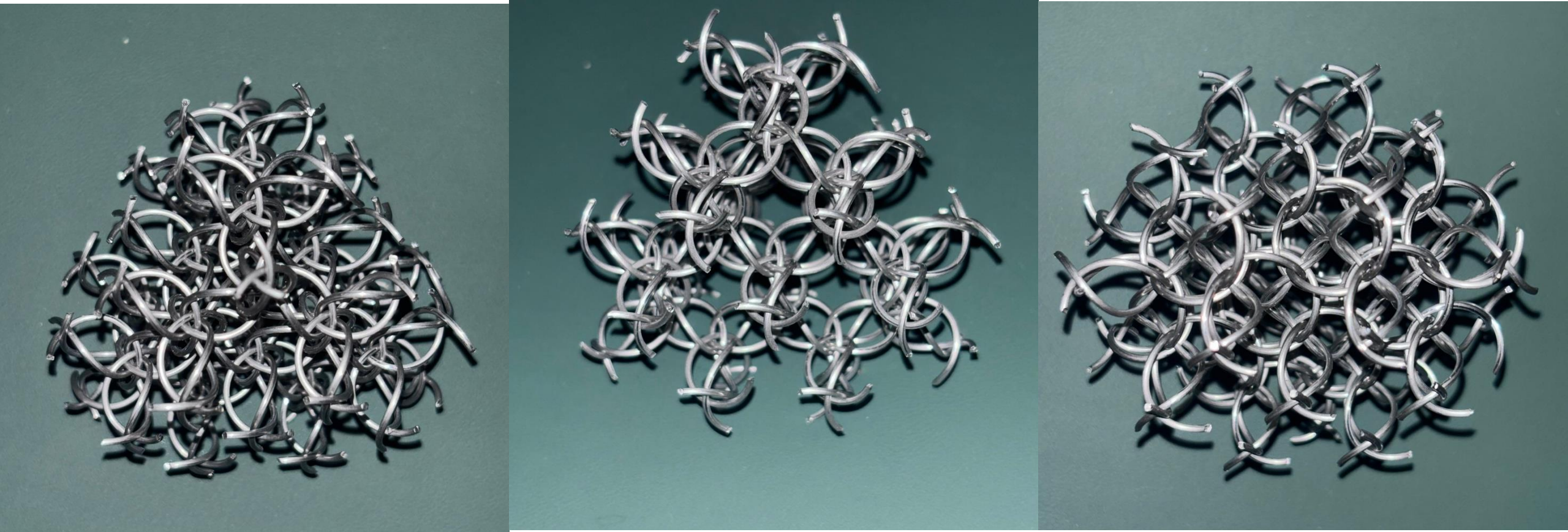
Discovered by Paul Gailiunas: 2023

<111> Clover Omega



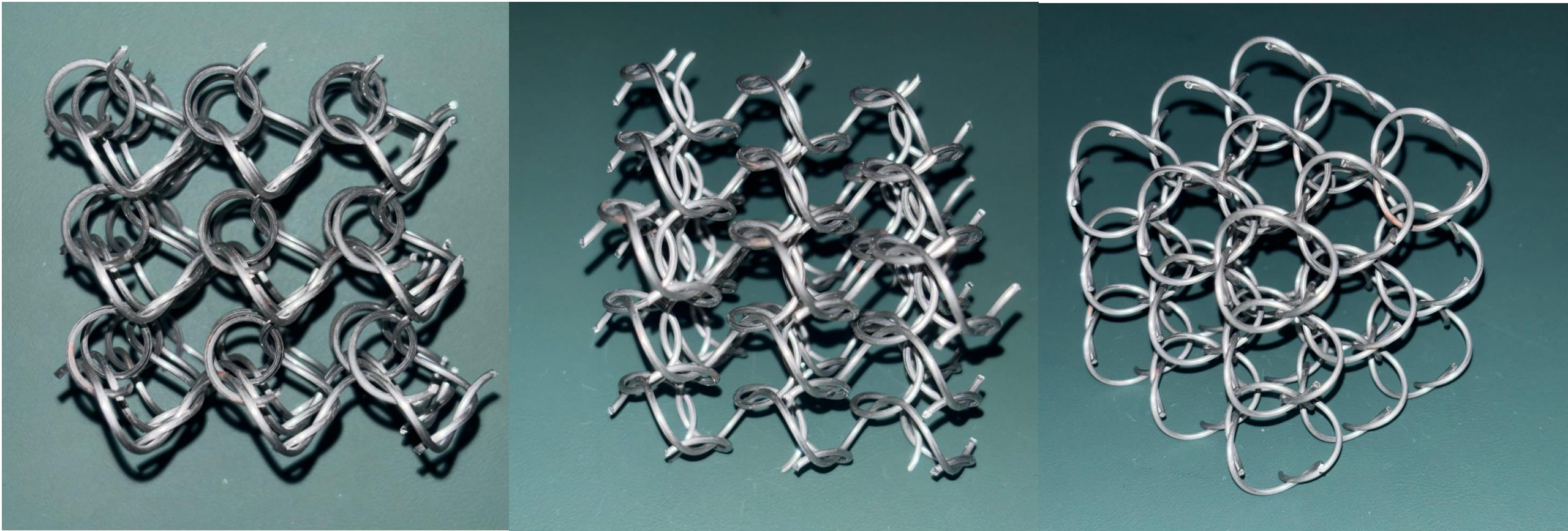
Discovered by Duston Wetzel: 2026

<110> Borromean Diamond



Discovered by Alexandru Usineviciu/Duston Wetzel: 2024

<100> Simple Annular



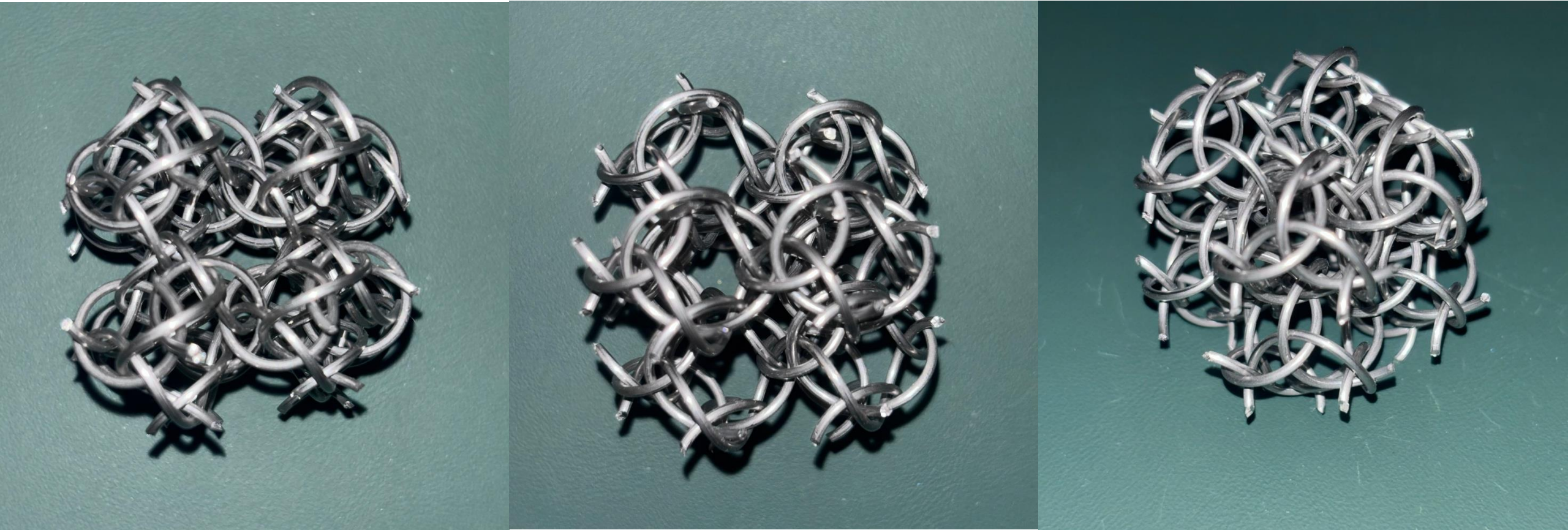
Discovered by Alexandru Usineviciu: 2015, Independently rediscovered by Moses Gaither-Ganim: 2023

<100> Simple Clover



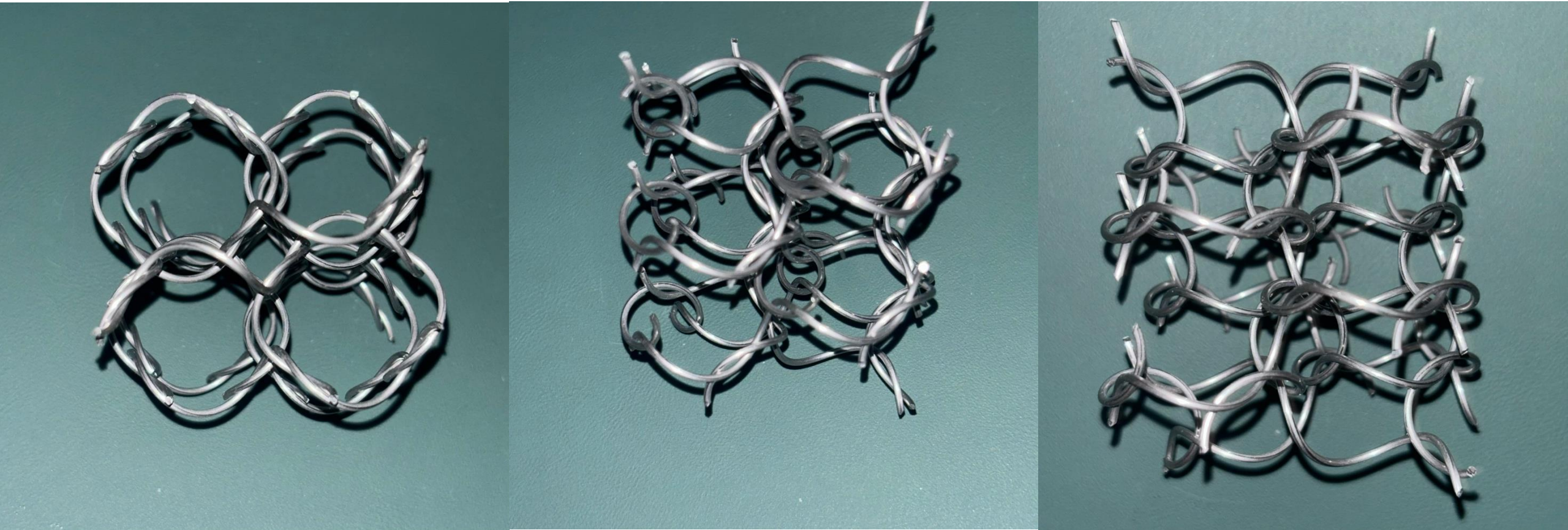
Discovered by Duston Wetzel: 2025

<100> Trefoil Tetrahedral



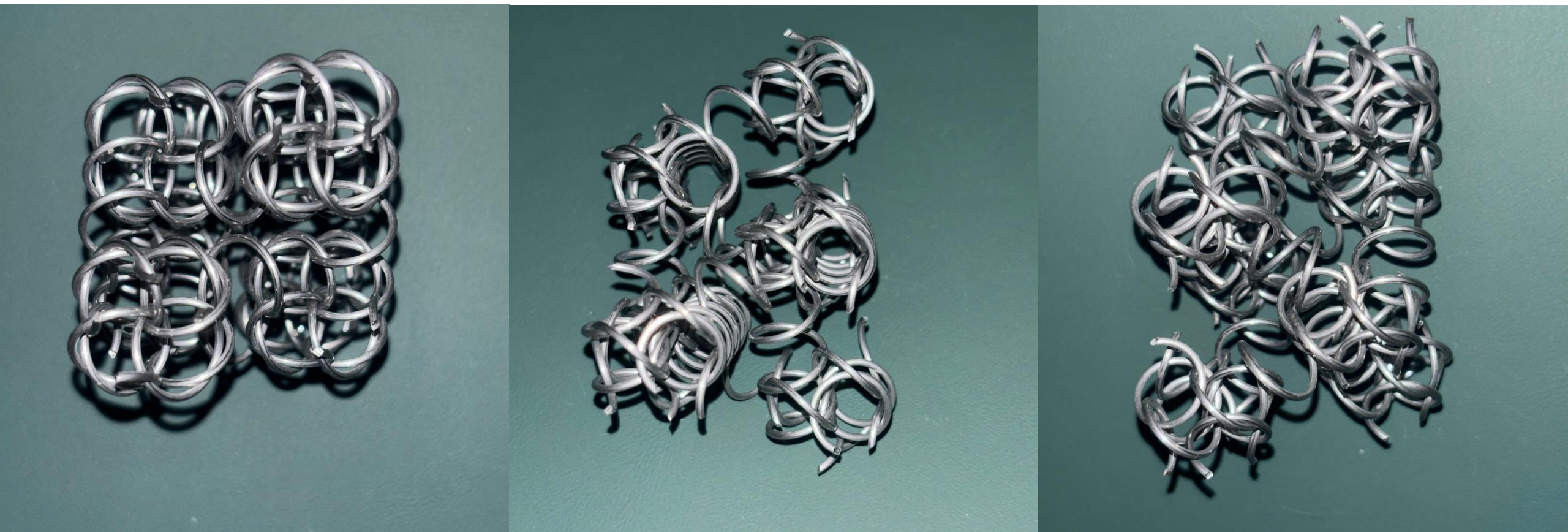
Discovered by Duston Wetzel: 2023

<111> Simple Annular



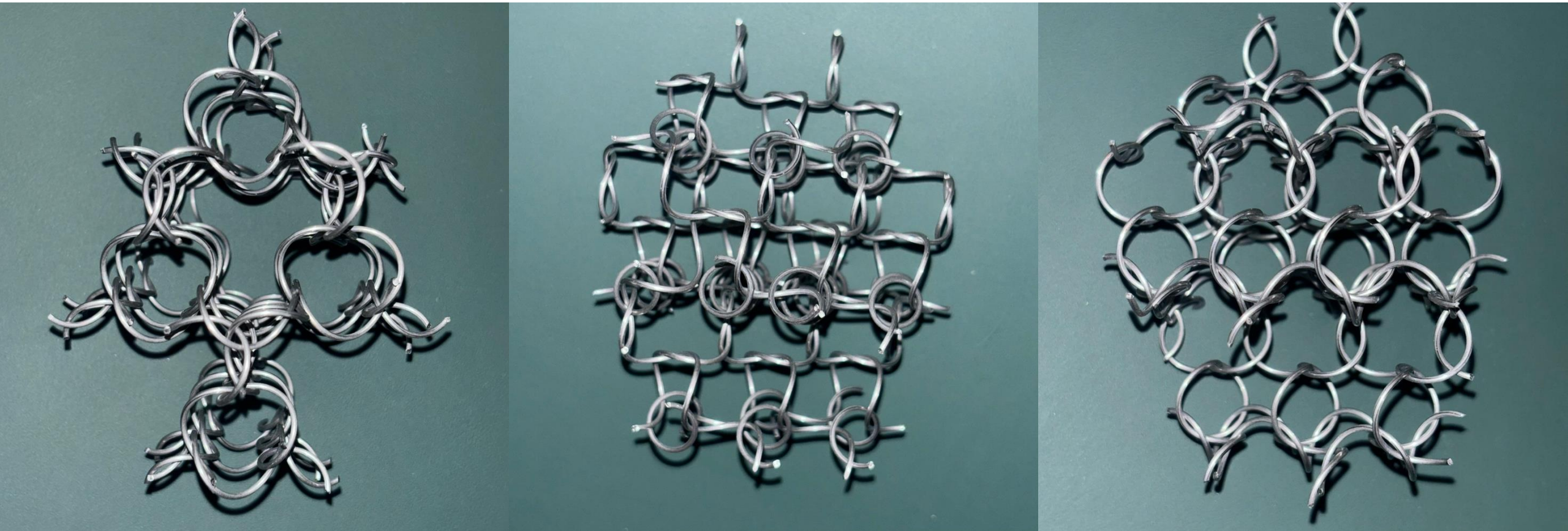
Discovered by Duston Wetzel: 2024

<111> Simple Clover



Discovered by Duston Wetzel: 2025

<111> Simple Annular/Trefoil



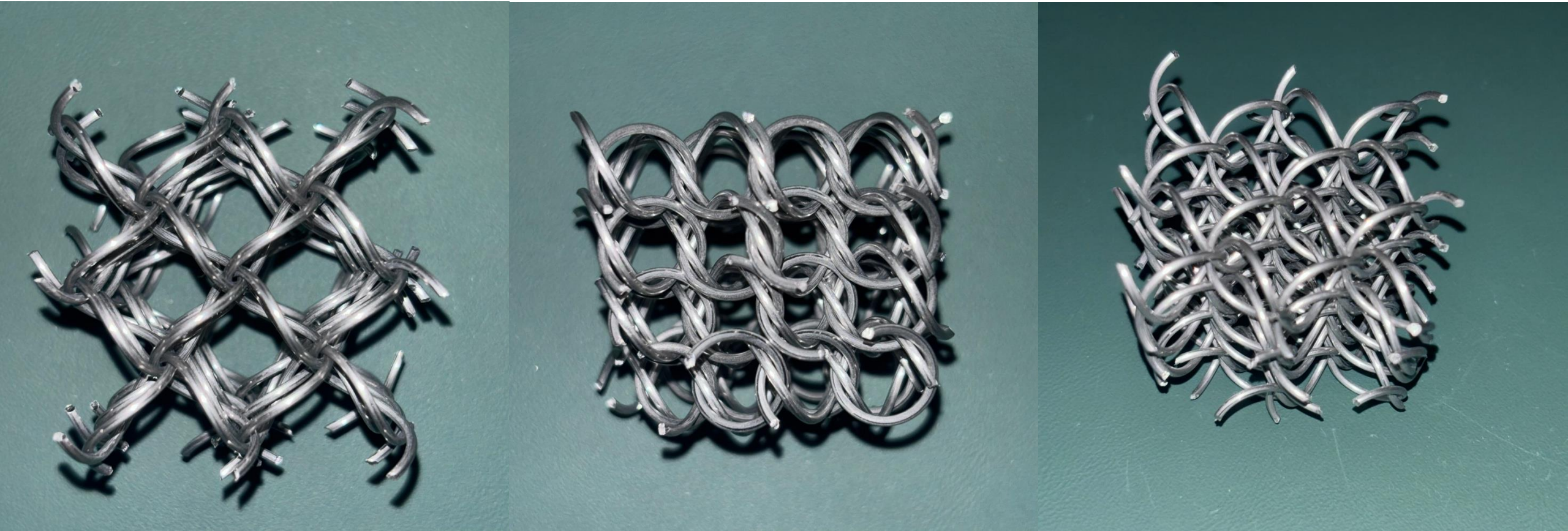
Discovered by Duston Wetzel: 2026

Stacked Hexagonal Moorish Fretwork



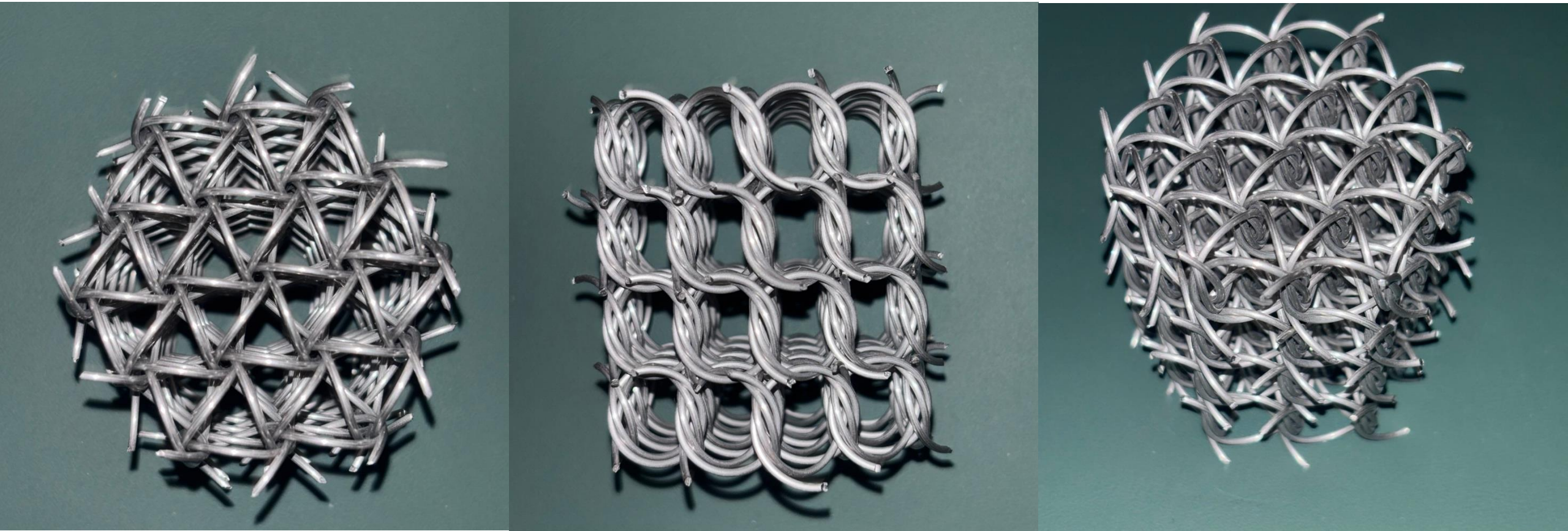
Discovered by Duston Wetzel: 2024

Strucwire™



Discovered by Jens Kieselstein: 2008 ?

Triangular Strucwire



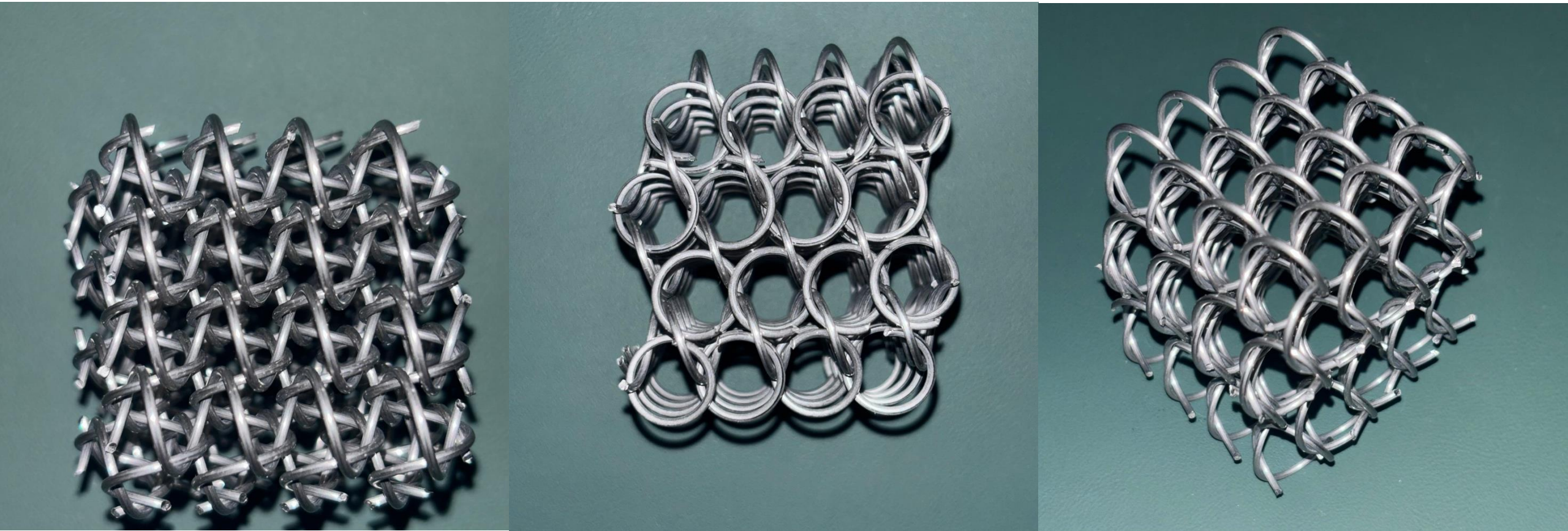
Discovered by Duston Wetzel: 2025

Staggered Square Chain-link



Discovered by Duston Wetzel: 2026

Offset Staggered Square



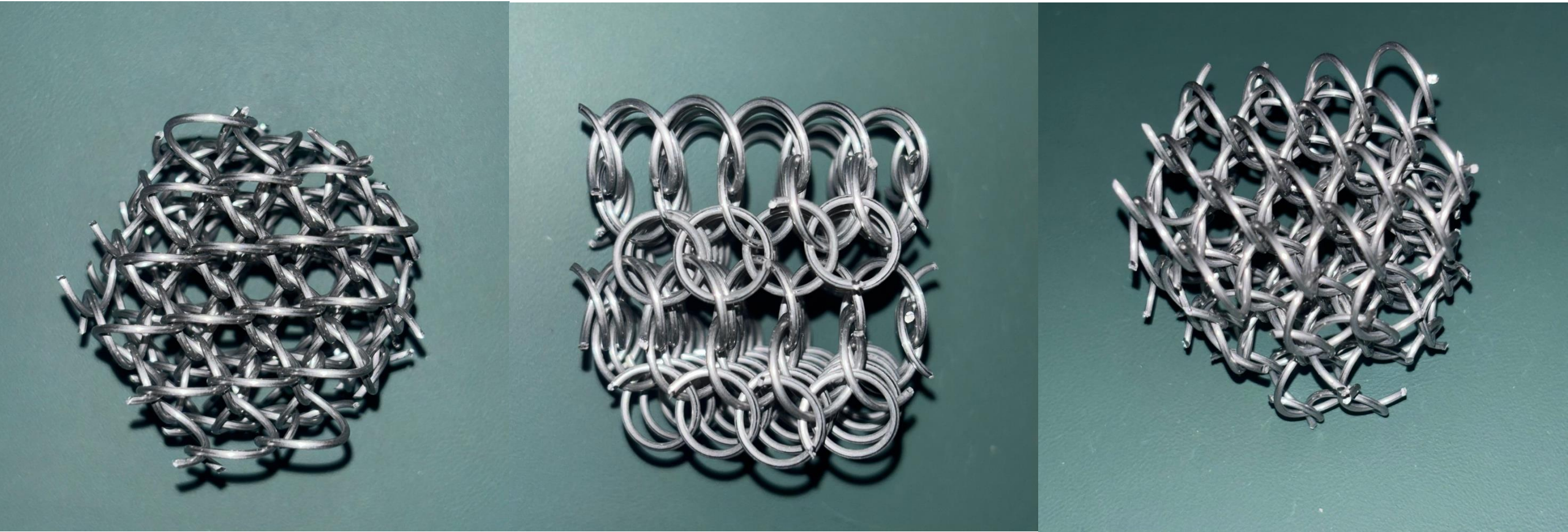
Discovered by Duston Wetzel: 2026

Staggered XO



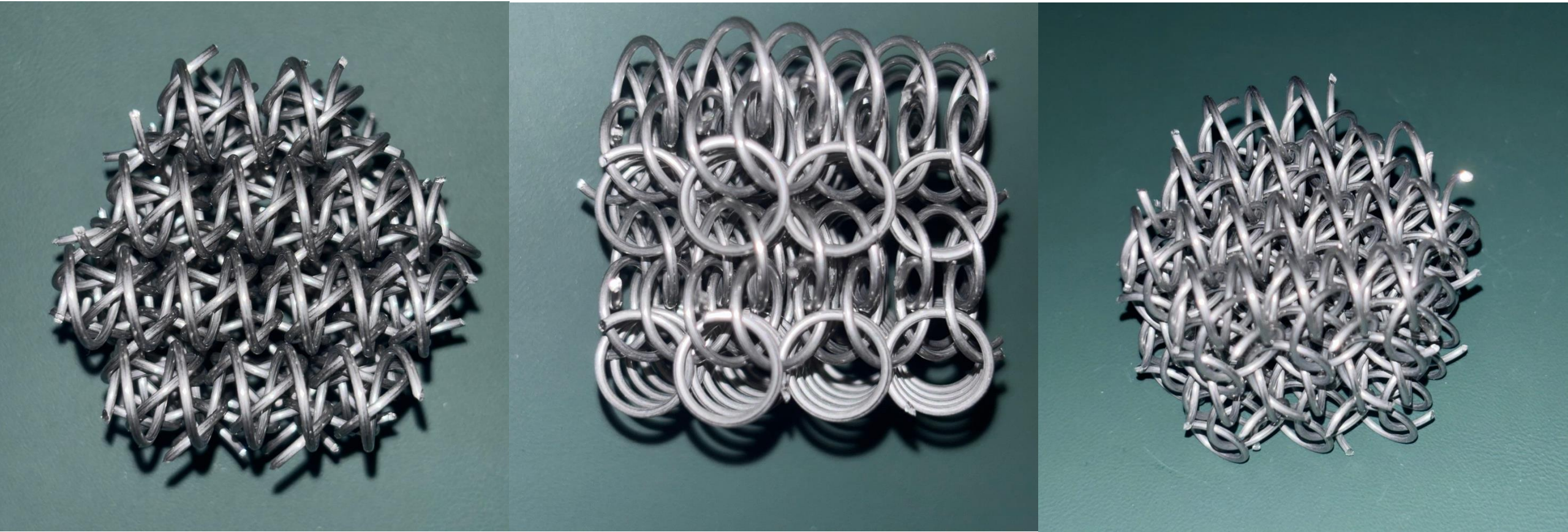
Discovered by Duston Wetzel: 2026

Staggered Hexagonal Chain-Link



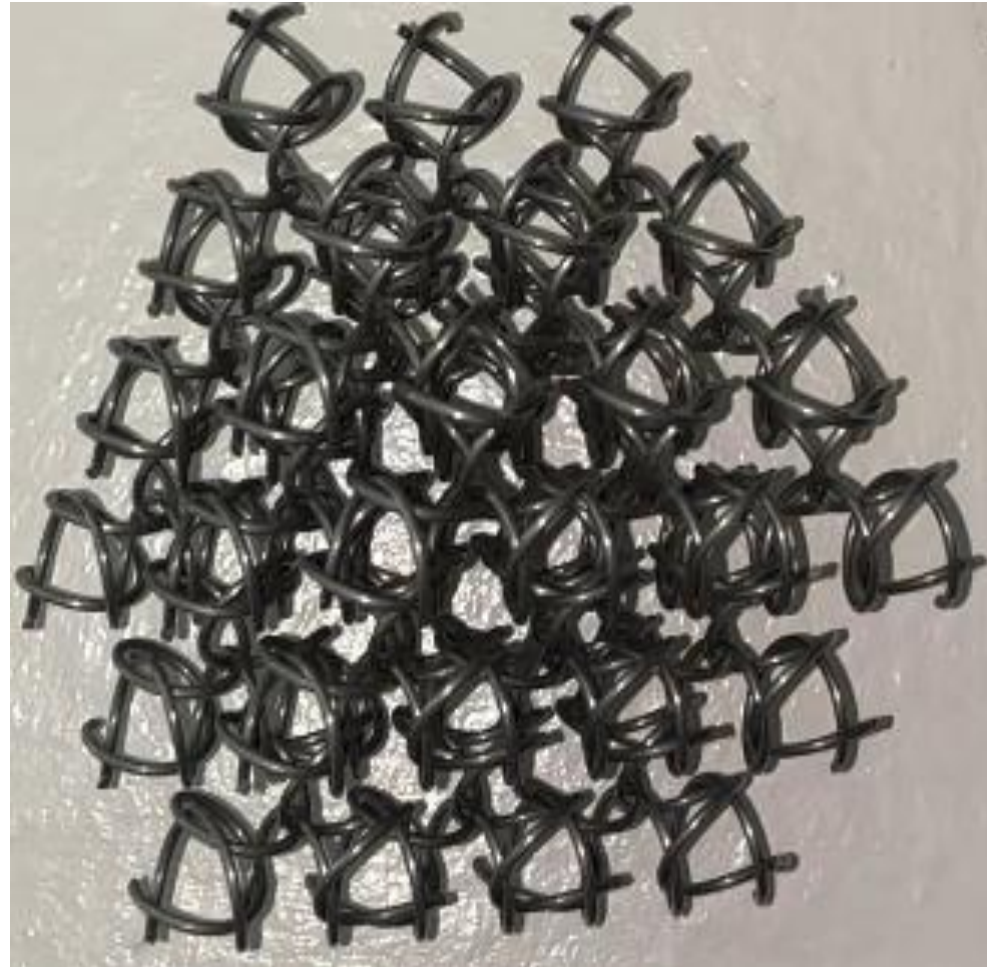
Discovered by Duston Wetzel: 2026

Staggered Hexagonal Double-Link

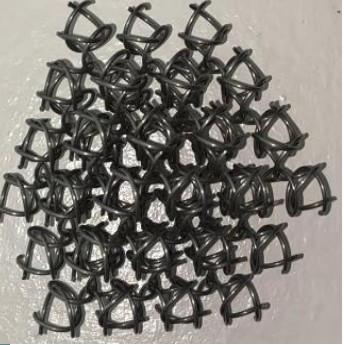
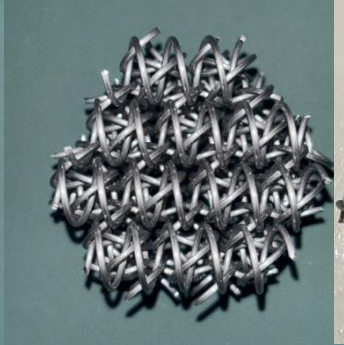
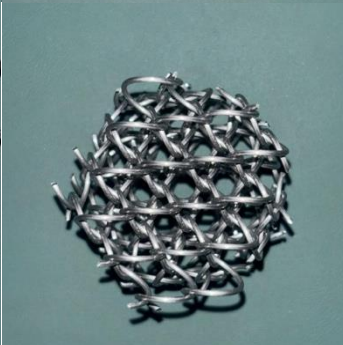
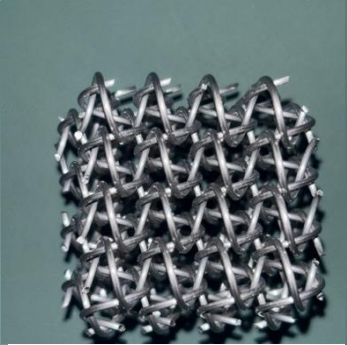
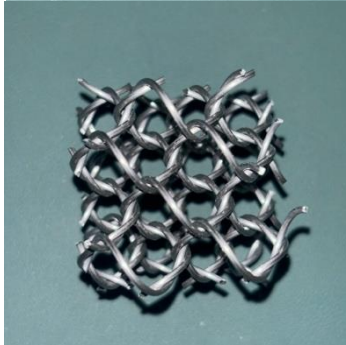
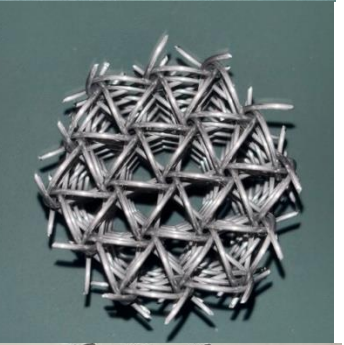
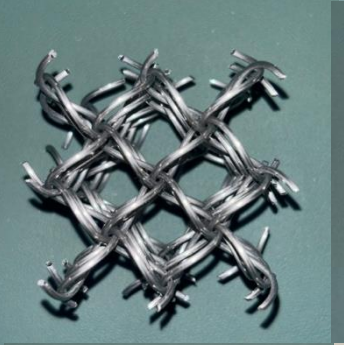
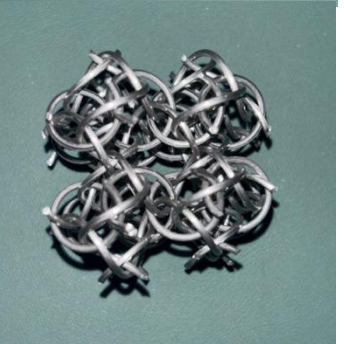
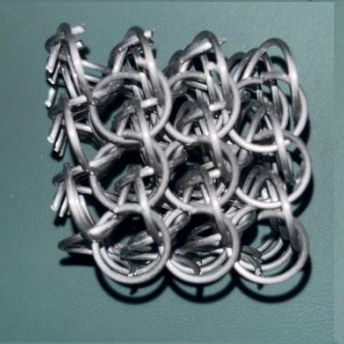
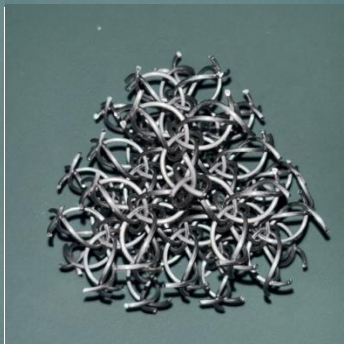
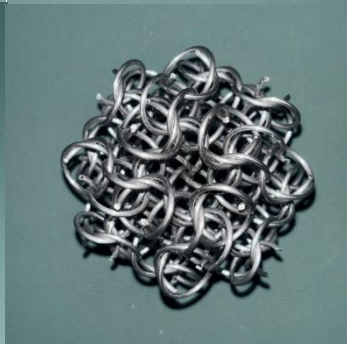
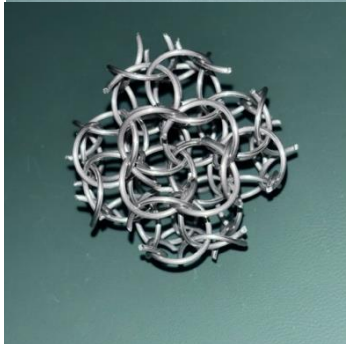
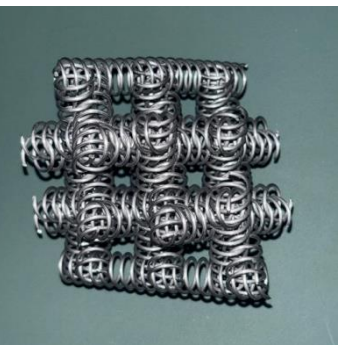
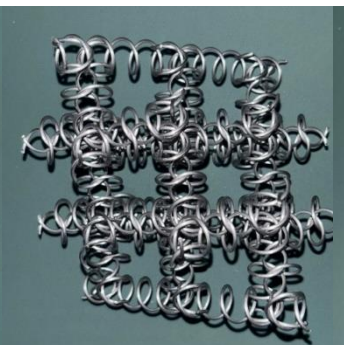
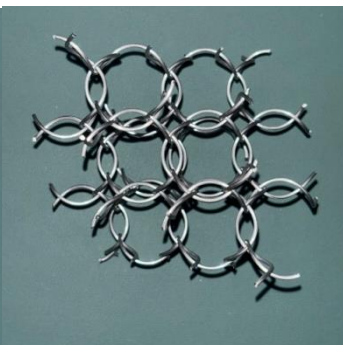
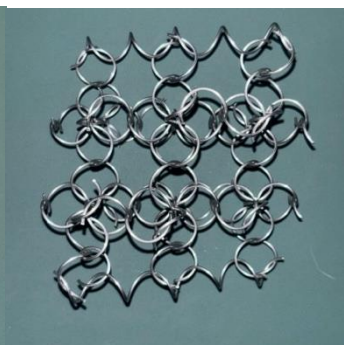
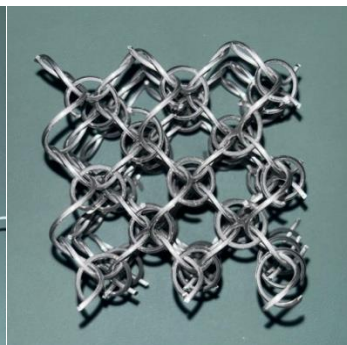
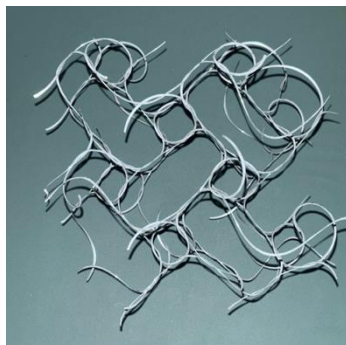


Discovered by Duston Wetzel: 2026

<100> Simple Double-Link



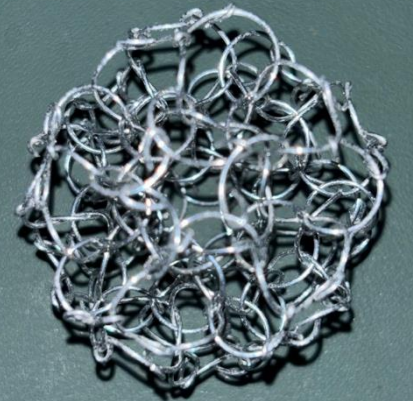
Discovered by Alexandru Usineviciu



Wetzelweaves



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Physicist / Artist
1-660-254-2478
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instagram.com/wetzelweaves



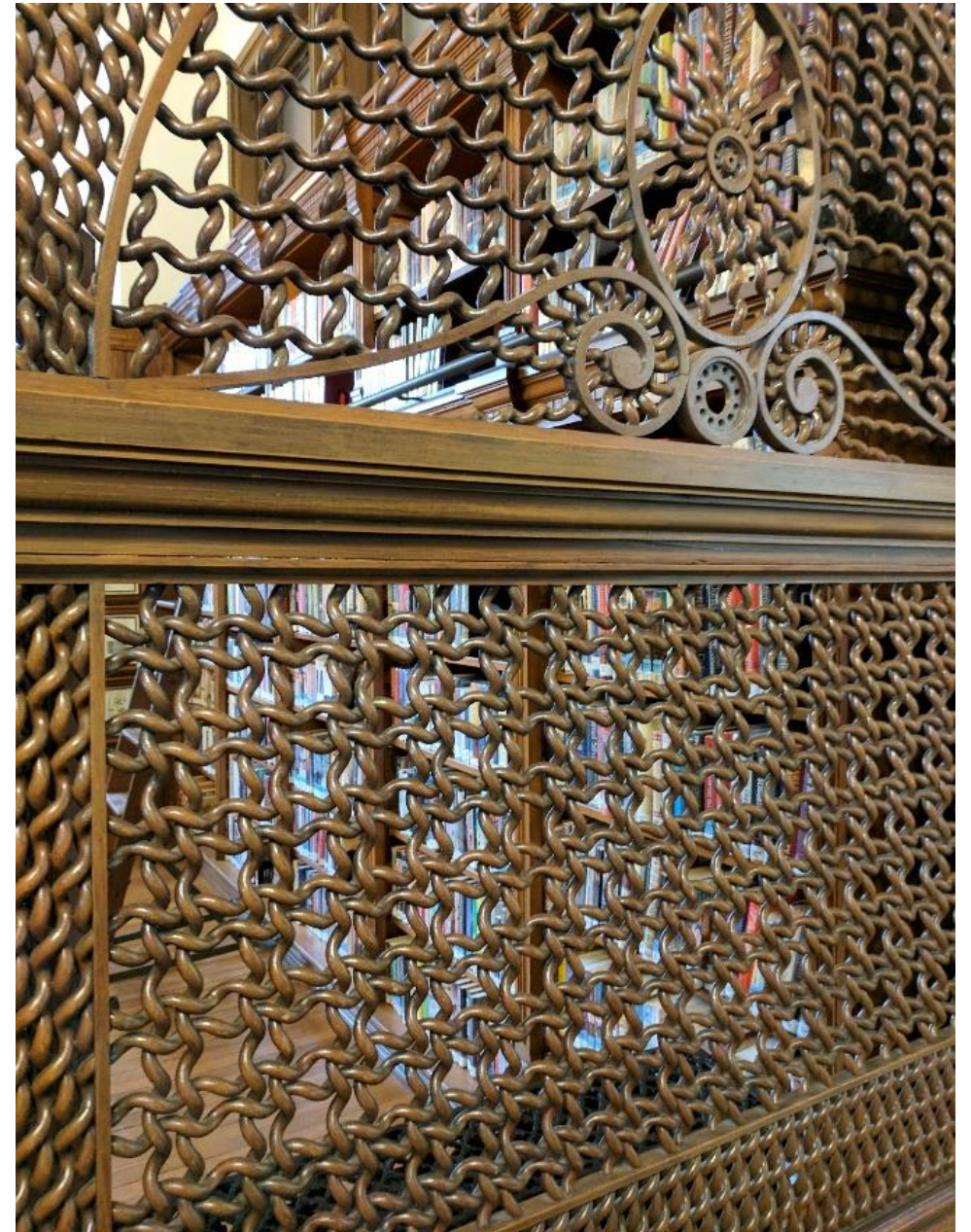
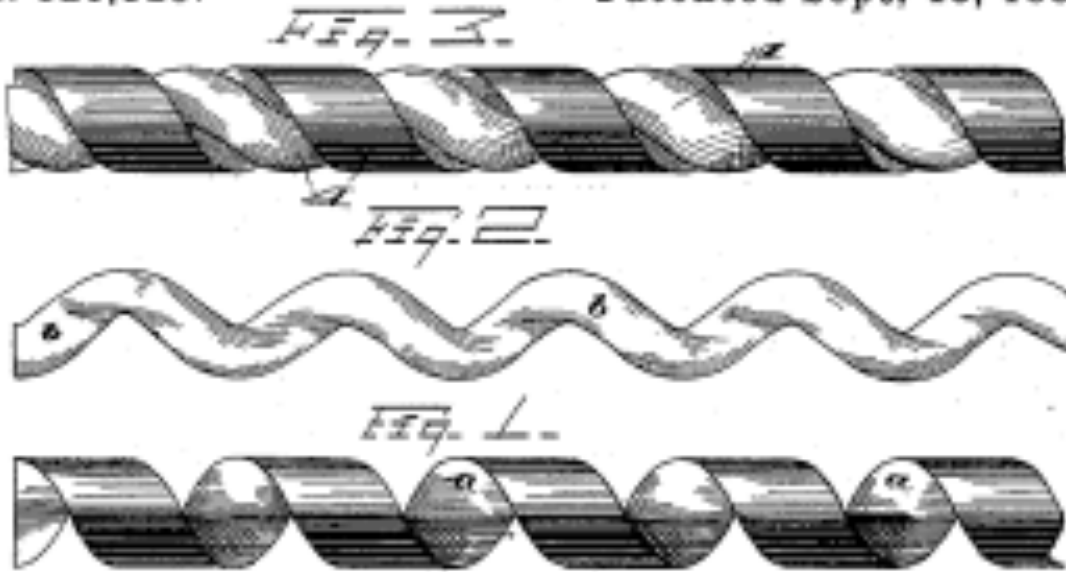


Moses Ransom

<https://archive.bridgesmathart.org/2004/bridges2004-181.pdf>

<https://archive.bridgesmathart.org/2012/bridges2012-223.pdf>

(NO MODEL.)
M. Y. RANSOM.
INTERLOCKING SPIRAL MOLDING AS AN ARTICLE OF MANUFACTURE.
No. 326,329. Patented Sept, 15, 1885.

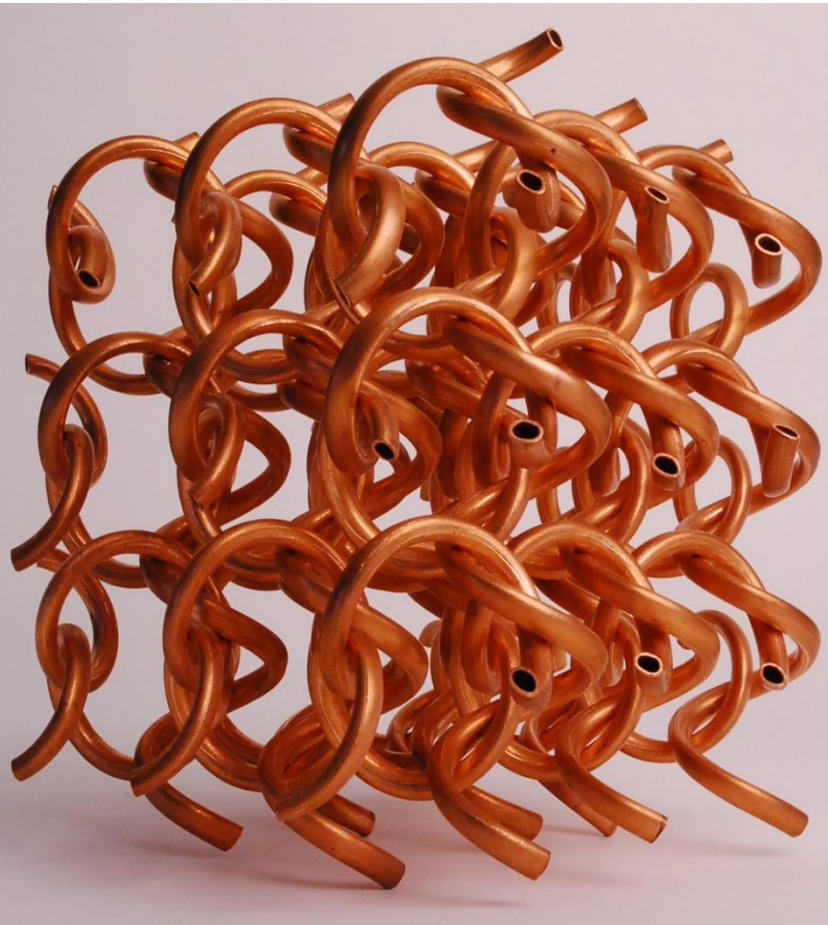


Alexandru Usineviciu

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<https://www.instagram.com/wievingwithwirehelixes/>

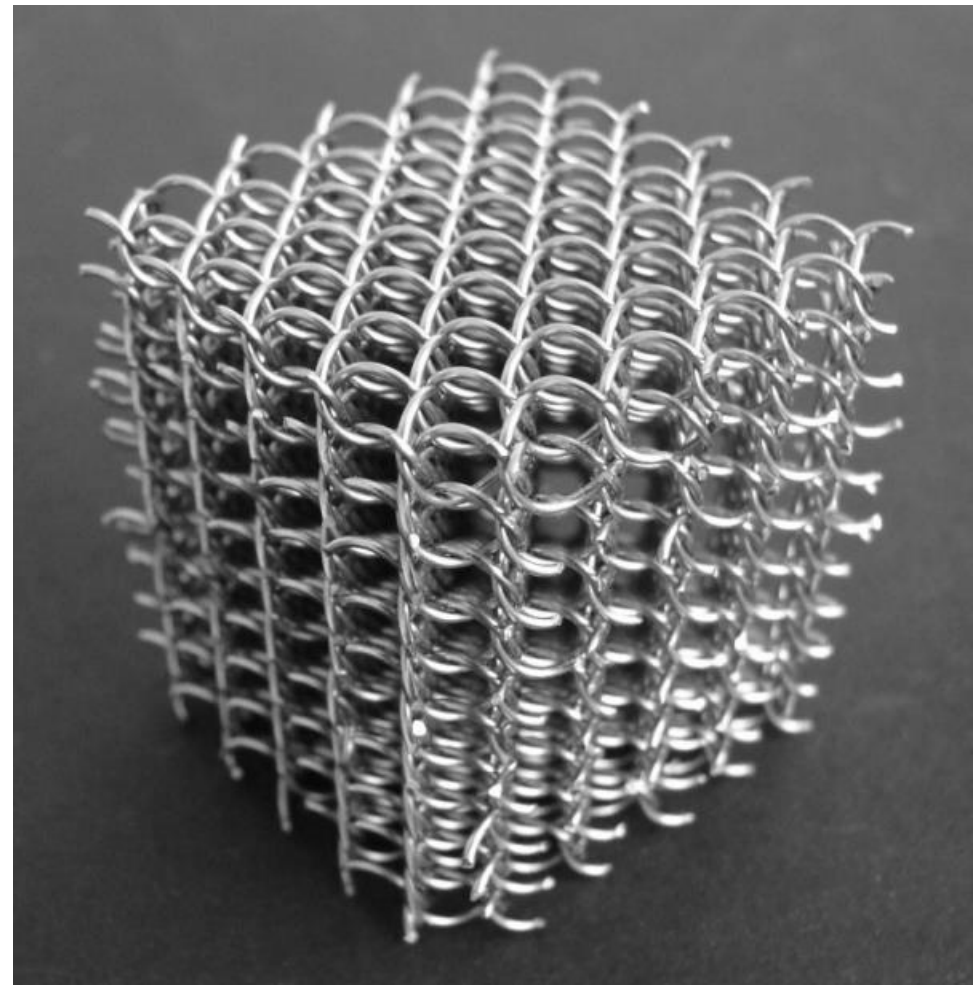
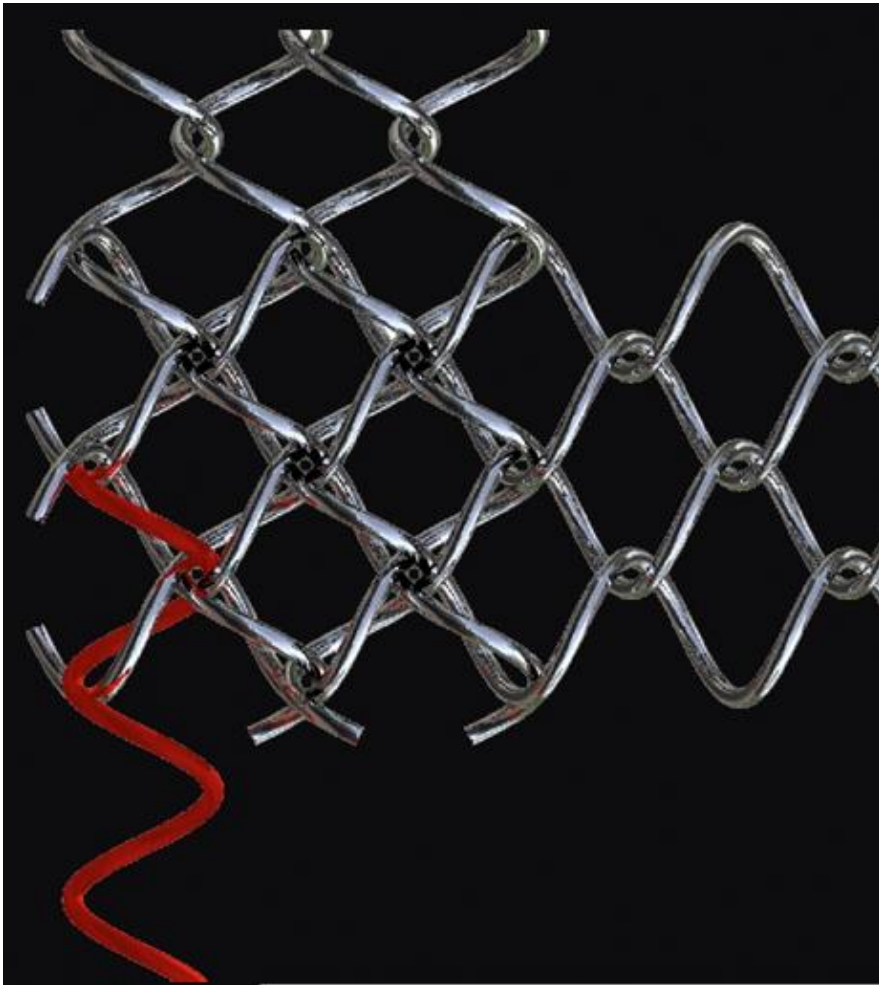
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Jens Kieselstein

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https://www.kieselstein.com/en/Wire-Products/strucwire_1105.html

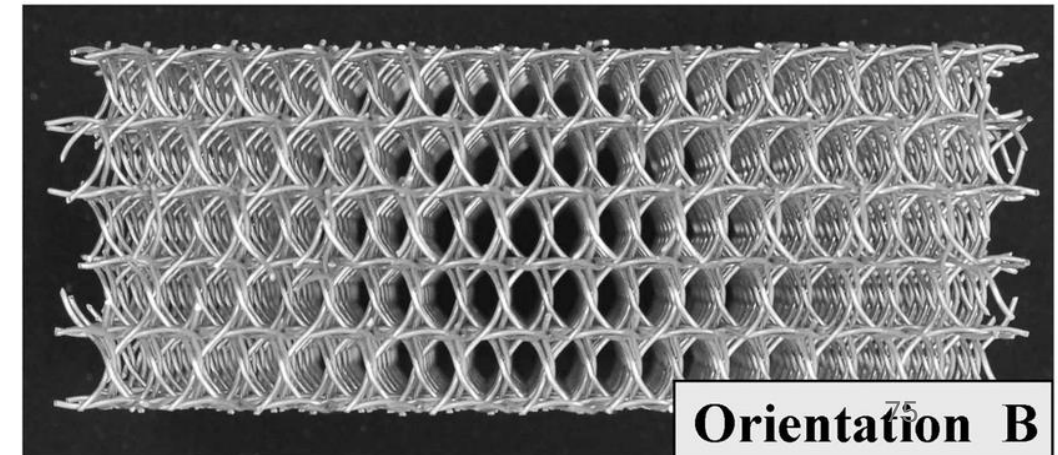
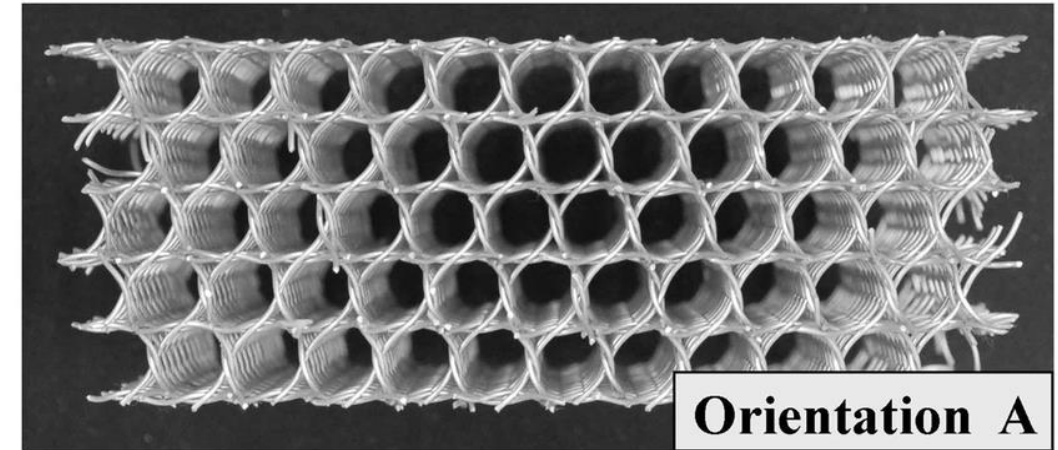
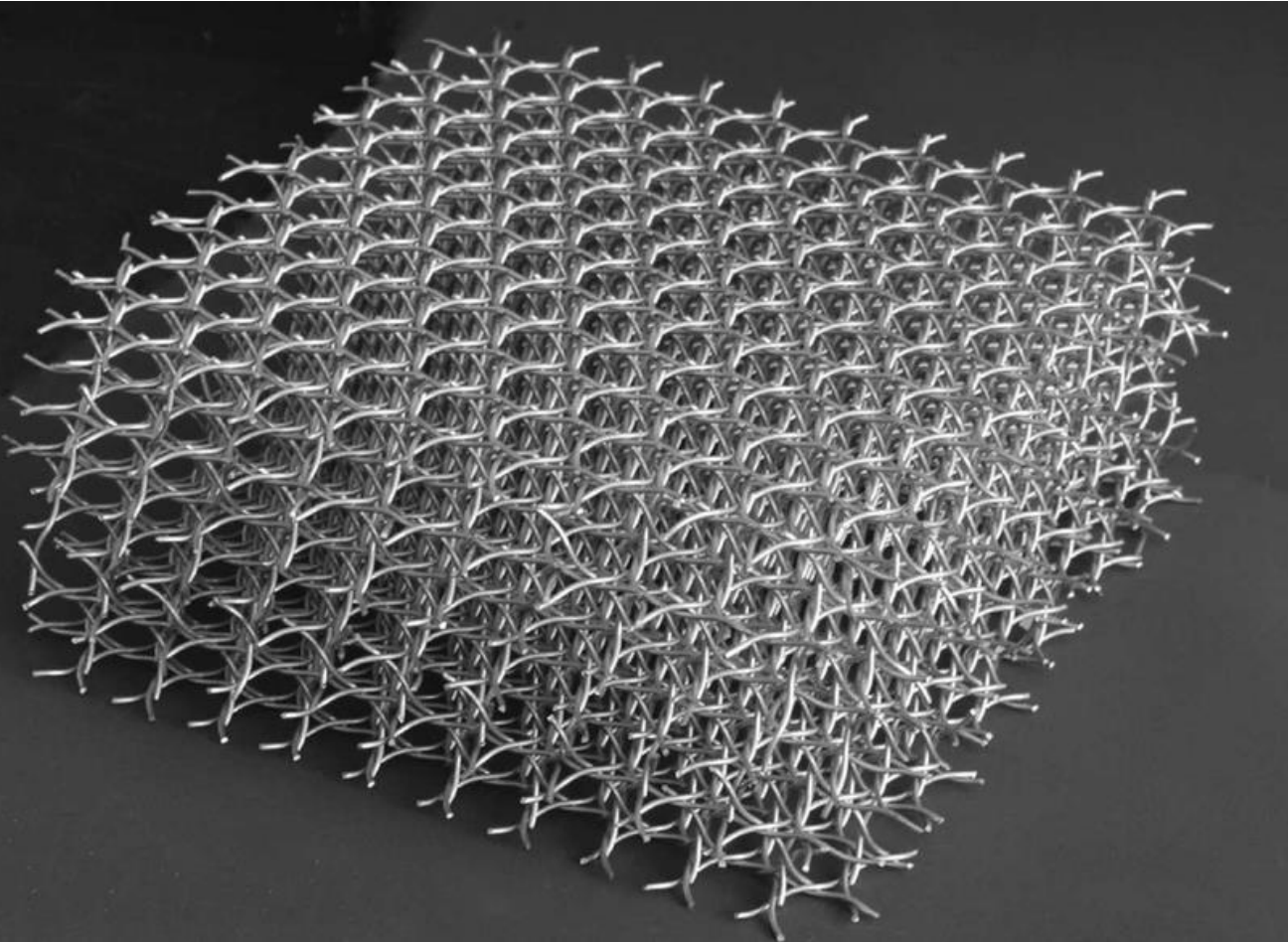


Kiju Kang

<https://www.researchgate.net/profile/Kiju-Kang>

https://www.researchgate.net/publication/268884329_Wire-woven_cellular_metals_The_present_and_future

https://www.researchgate.net/publication/251730201_Forced_convective_heat_transfer_in_all_metallic_wire-woven_bulk_Kagome_sandwich_panels

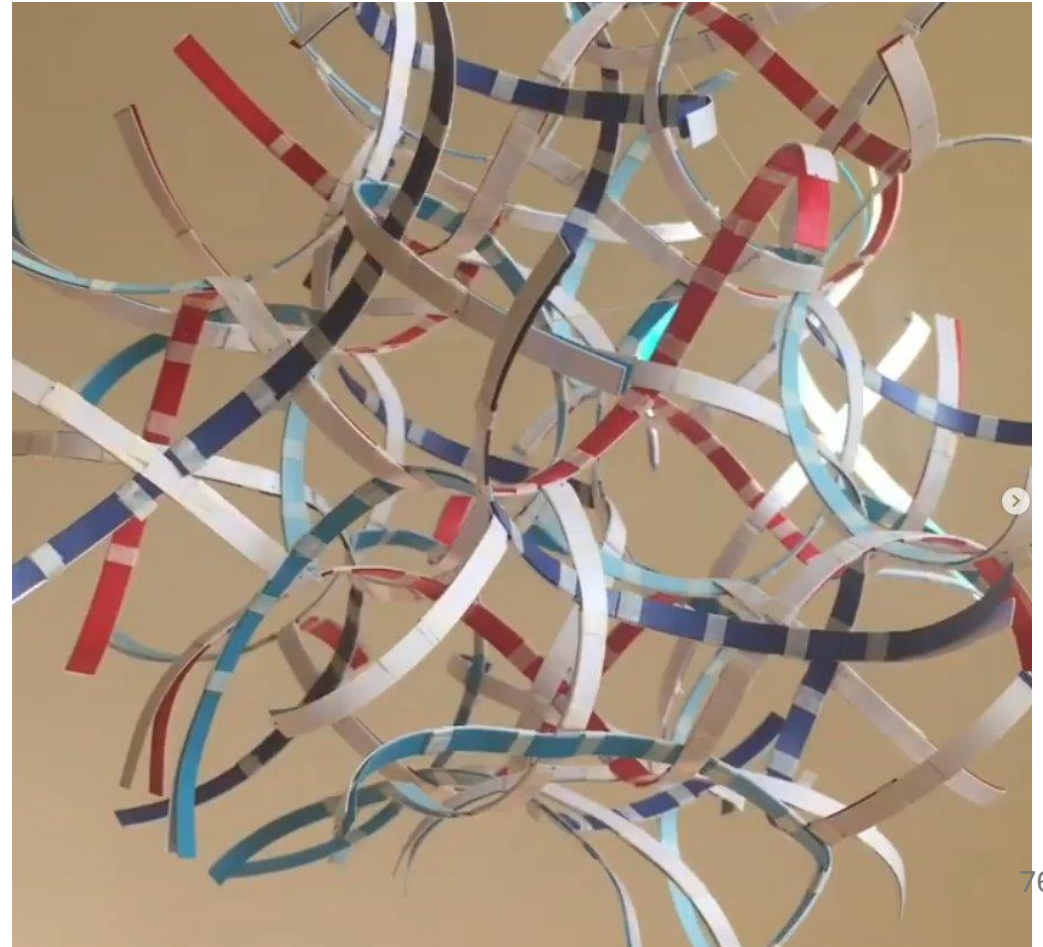
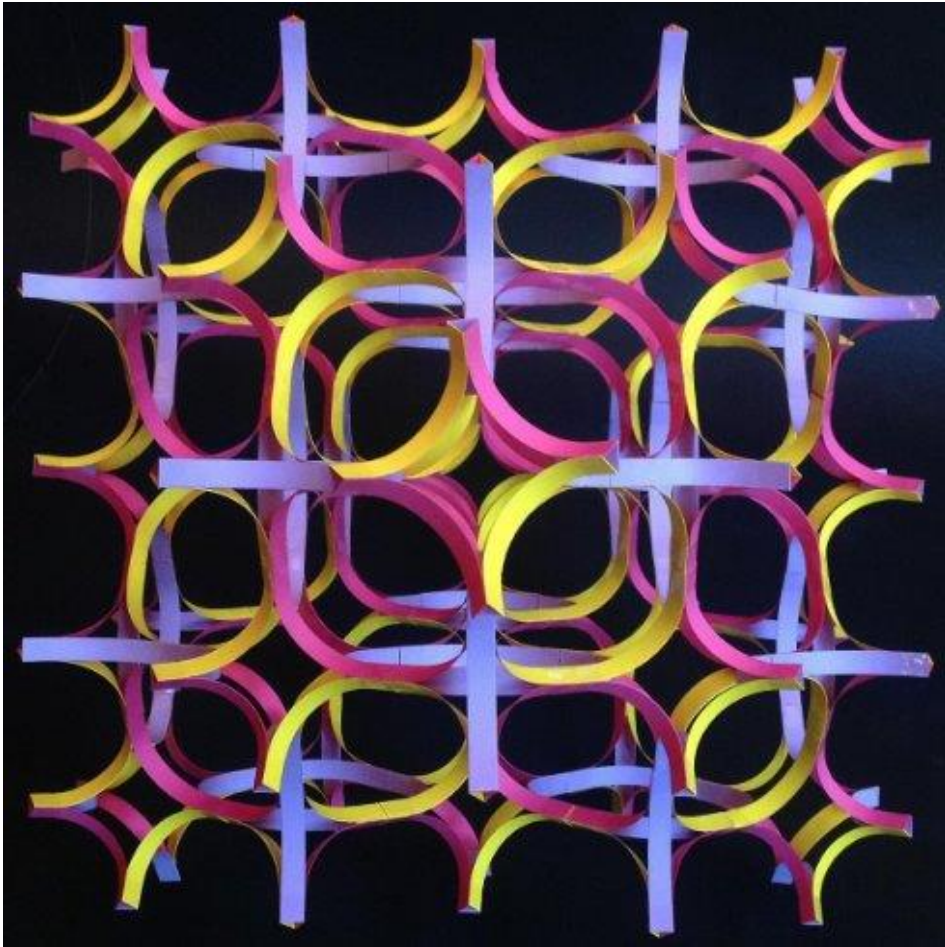


Alison Martin

<https://gallery.bridgesmathart.org/artists/K4b5Q8/alison-grace-martin>

<https://www.instagram.com/alisonmartin57/?hl=en>

<https://www.youtube.com/@alisonmartin57/videos>



Oskar Van Derventer

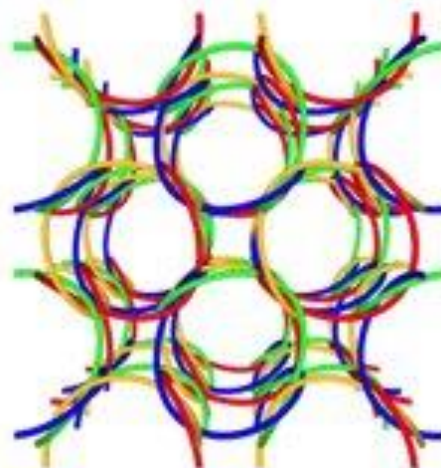
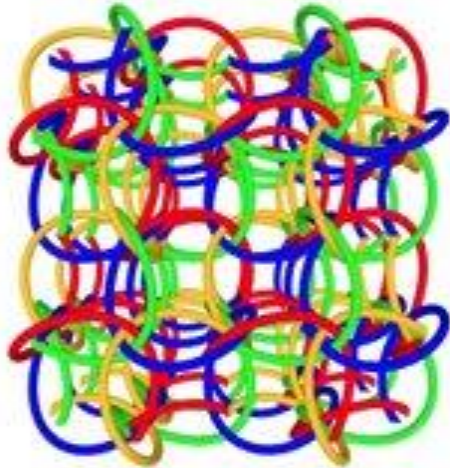
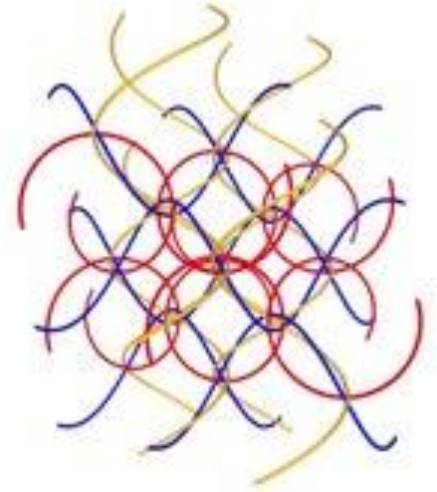
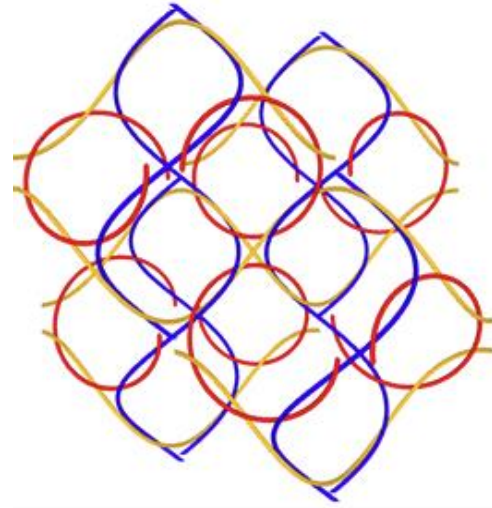
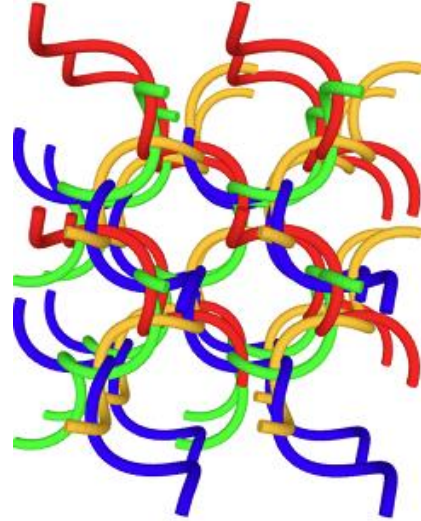
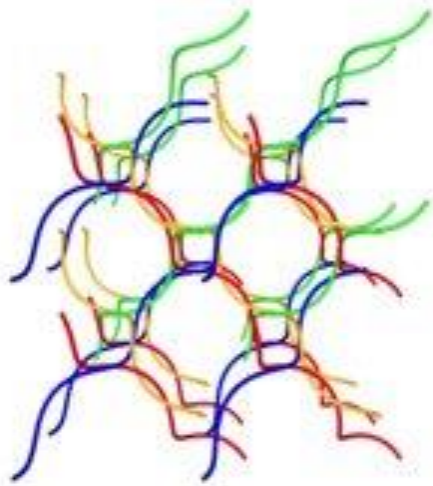
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Paul Gailiunas

<https://uk.linkedin.com/in/paul-gailiunas-004a90b1>

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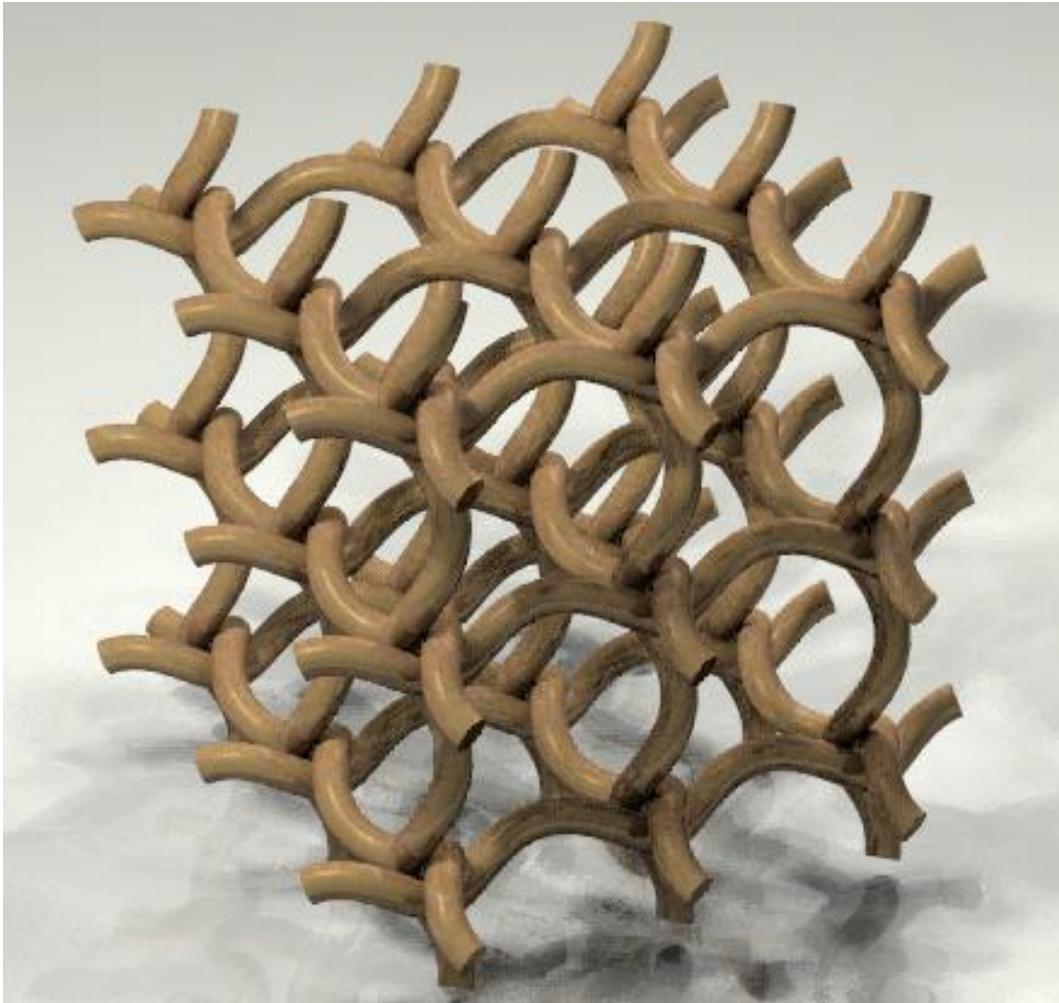


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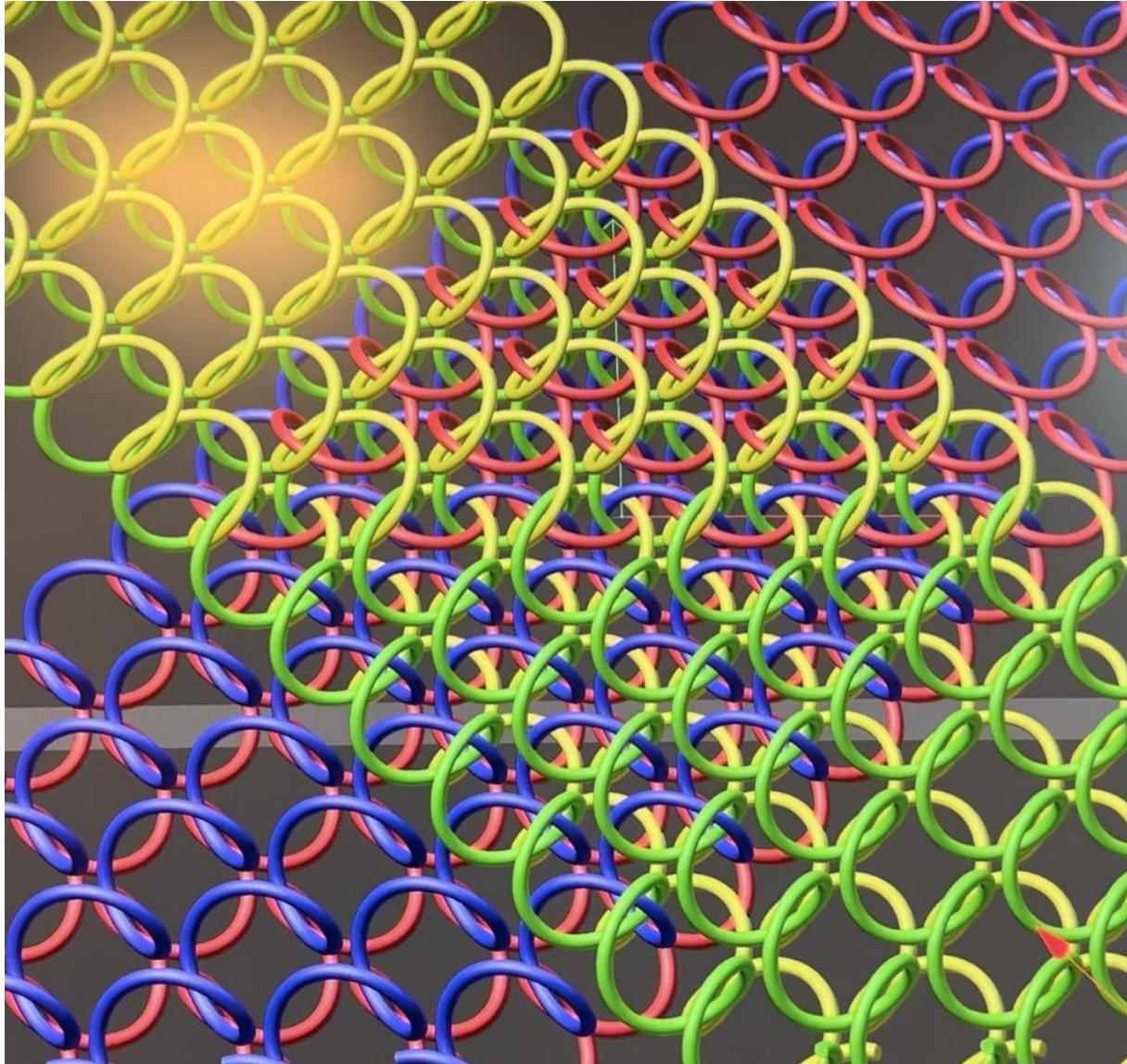
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<https://www.rinusroelofs.nl/rhinoceros/spaceframe/sp-frame-026.html>

https://www.facebook.com/rinus.roelofs.3/about/?_rdr



Wenjie Zhou





Hierarchical woven fibrillar structures in developing single gyroids in butterflies

Anna-Lee Jessop^{a,b,c,1}, Peta L. Clode^{d,e}, Martin Saunders^d, Myfanwy E. Evans^f, Stephen T. Hyde^{g,h}, James N. McPhersonⁱ, Kasper S. Pedersen^j, Jacob J. K. Kirkensgaard^k, Nipam H. Patel^l, Kyle A. DeMarr^m, W. Owen McMillan^b, Bodo D. Wilts^c, and Gerd E. Schröder-Turk^{a,h,i,j,k}

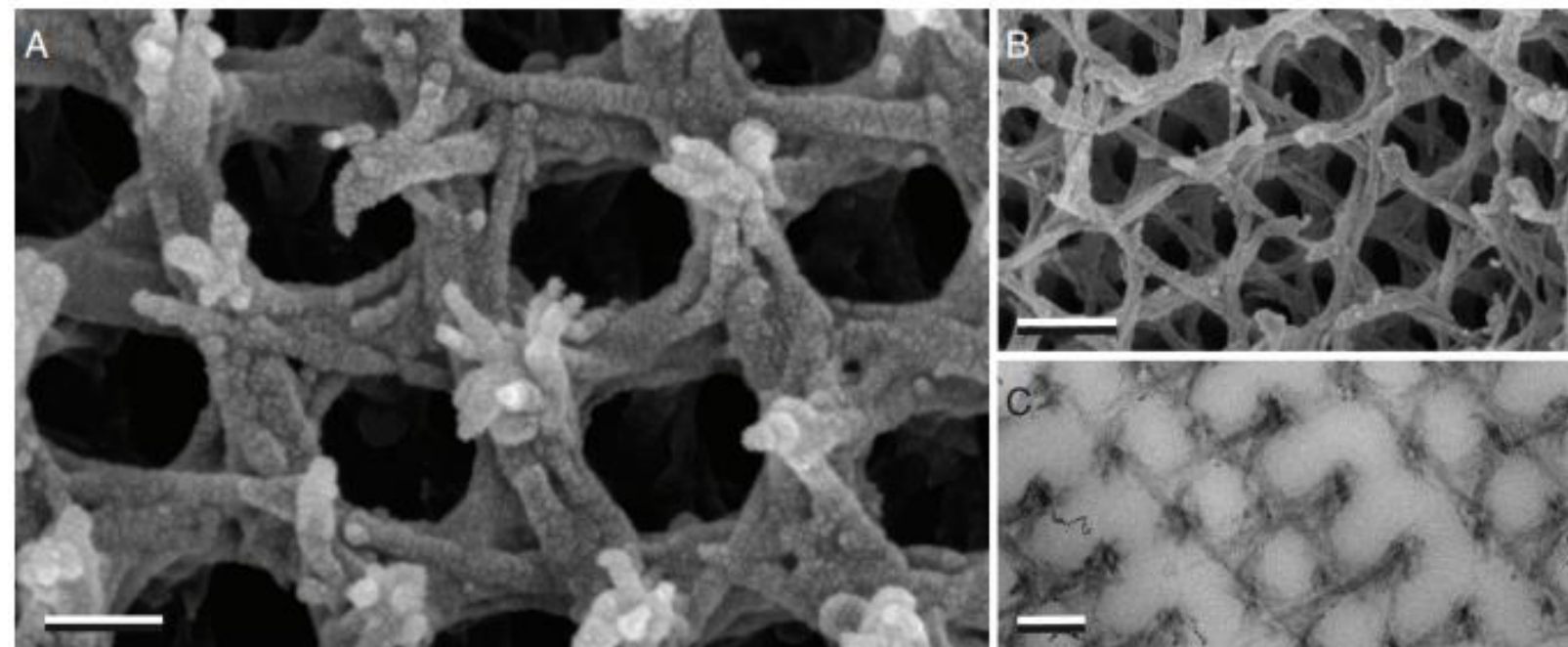


Fig. 2. Electron microscopy images of the fibrillar gyroid structures found in the wing scales of developing *P. sesostris* pupae. Wing scale development was arrested via fixation at day 13 (70% development; A) and day 15 (80% development; B and C), of an approximate 18 d pupation period. (A) A fibrillar gyroid structure adjacent to the lower lamina of the wing scale from a critical-point dried sample shows approximately six entangled fibers making up the gyroid structure. (B) The fibrillar gyroid structure closer to the upper lamina of the wing scale from a critical-point dried sample shows two–three entangled fibers. (C) A TEM cross-sectional image of a wing scale sampled from the same wing displayed in (B) shows the fibrillar nature of the gyroid structure (black is cuticular material). The structures shown here are from individuals that, up to the fixation on day 13 and 15, respectively, have developed in natural conditions without any chemical or mechanical intervention or dissection. [Scale bars: (A) 100 nm, (B) 200 nm, and (C) 200 nm.]



Hierarchical woven fibrillar structures in developing single gyroids in butterflies

Anna-Lee Jessop^{a,b,c,1}, Peta L. Clode^{d,e}, Martin Saunders^d, Myfanwy E. Evans^f, Stephen T. Hyde^{g,h}, James N. McPhersonⁱ, Kasper S. Pedersen^j, Jacob J. K. Kirkensgaard^k, Nipam H. Patel^l, Kyle A. DeMarr^m, W. Owen McMillan^b, Bodo D. Wilts^c, and Gerd E. Schröder-Turk^{a,h,i,j,k}

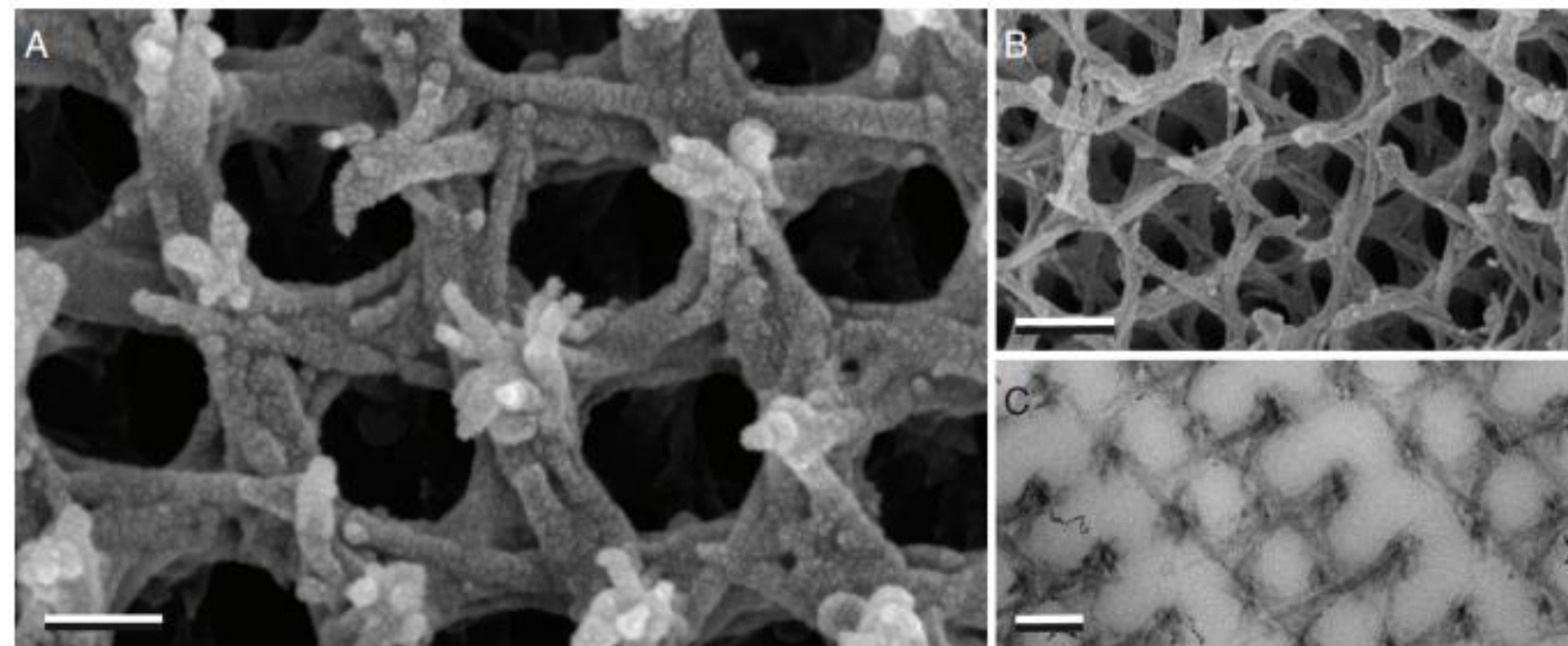


Fig. 2. Electron microscopy images of the fibrillar gyroid structures found in the wing scales of developing *P. sesostris* pupae. Wing scale development was arrested via fixation at day 13 (70% development; A) and day 15 (80% development; B and C), of an approximate 18 d pupation period. (A) A fibrillar gyroid structure adjacent to the lower lamina of the wing scale from a critical-point dried sample shows approximately six entangled fibers making up the gyroid structure. (B) The fibrillar gyroid structure closer to the upper lamina of the wing scale from a critical-point dried sample shows two-three entangled fibers. (C) A TEM cross-sectional image of a wing scale sampled from the same wing displayed in (B) shows the fibrillar nature of the gyroid structure (black is cuticular material). The structures shown here are from individuals that, up to the fixation on day 13 and 15, respectively, have developed in natural conditions without any chemical or mechanical intervention or dissection. [Scale bars: (A) 100 nm, (B) 200 nm, and (C) 200 nm.]



<https://www.linkedin.com/in/alison-grace-martin-856abb50/>



What do we do with this?...

