The face centred cubic structure (fcc)

As the name itself suggests, the face centred cubic structure has a cube-shaped unit cell. The length of each edge is given by the lattice parameter 'a'. There is a lattice point at each corner of the cube, which marks the position of the atoms. This is similar to the simple cubic structure. However, there is also another atom at the centre of each the cubes faces.

With this model sheet and instructions, you can make your own 3D paper model of a face centred cubic crystal, similar to one shown in the image. Once you are done, see if the 3D model makes it easier for you to answer the questions at the end

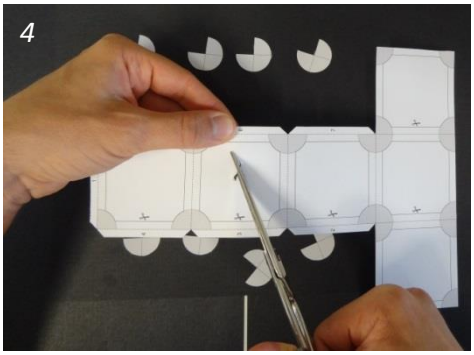
To make this paper crystal you will need:

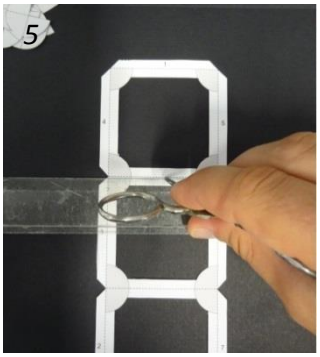
- *2 sheets of paper card (A4 size), 150-200 gsm*
- *Crayons, colours pencils*
- *Scissors or paper knife*
- *Ruler*
- *Craft glue, or a glue stick*

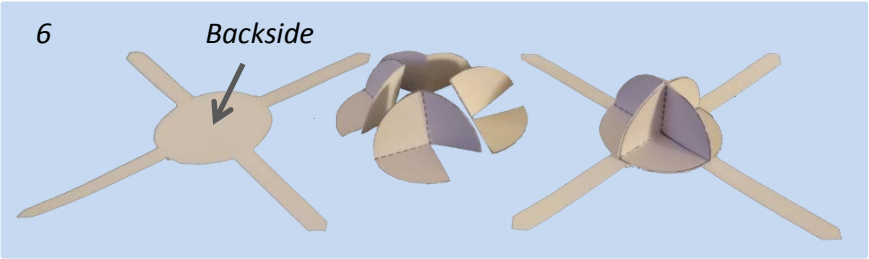
Paper cards, crayons, ruler, and scissors needed for the paper model

Instruction

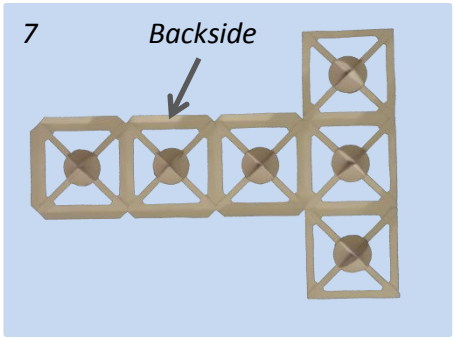
1. *Download the model sheet from our homepage, and print it one-sided on the white A4 size paper cards.*
2. *Colour the grey shaded regions in your favourite colour. Use the same colour for all the grey fields.*
3. *Cut along the solid lines, and start with the outer shape. Cut out all pieces.*
4. *To remove the inner parts, make a small hole in each field with the tip of your scissor. Then use a fine, small scissor and cut carefully along the inner solid lines.*
5. *Put your ruler on the dashed lines, and score gently with the scissor tip along these lines. Fold along these lines.*





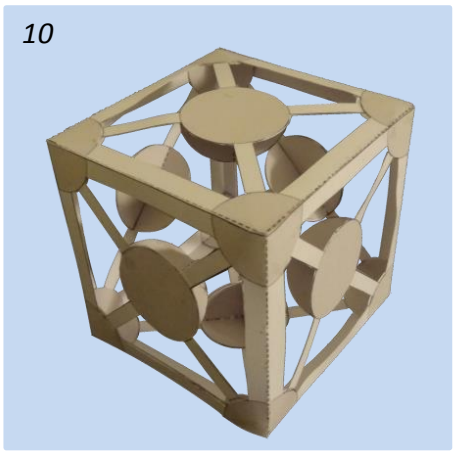


6. *Cut out the pieces of the second sheet. Fold and glue the ¾ circles on the backside of the cross-shaped pieces as shown above.*
7. *Glue these constructions in the middle of each of the cubes fields (backside) as shown in the right image.*
8. *Fold the construction to a cube. And stick the section 1 together.*
9. *Glue now the folded ¾ circles, which you have left, at the corners. Close and glue the bottom (sections: 2, 3, 4) and lid (sections: 5, 6, 7) of the cube.*
10. *Finished!*



Can you answer the questions on the crystal properties?

1. *How many nearest neighbours does each atom have? Take into account that several neighbouring unit cells surround each cubic unit cell.*
2. *How many atoms are in each face centred cubic unit cell?*
3. *What is the distance between nearest neighbours? (Use the length of the cube edge 'a' as a scaling parameter.)*
4. *The packing efficiency describes the ratio of the maximal volume occupied by the atoms and the volume of the cubic unit cell. In your 3D paper model, now assume that the neighbouring atoms are touching each other, then, what will be the packing efficiency for the face centred cubic structure? Compare the result with the values of other crystal structures.*



The final 3D paper model of the face centred cubic structure.

Enjoy your new 3D paper crystal!

For more learning resources from our group, visit
http://www.gan.msm.cam.ac.uk/resources

Follow us on: http://www.gan.msm.cam.ac.uk/
https://www.linkedin.com/company/10402127