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GOLDEN RESEARCH THOUGHTS

# CRYSTAL STRUCTURE AND MAGNETISM RELATION: AN OVERVIEW

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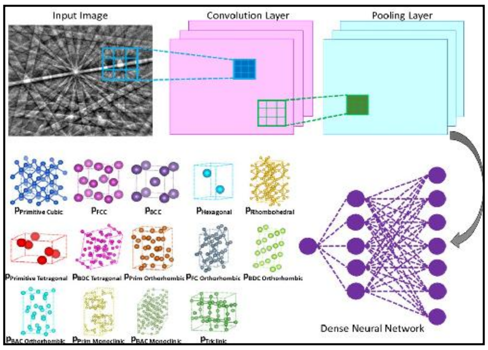
## ABSTRACT

*The present review article discusses the relationship between crystal structure and magnetism with new insight into the fundamentals of solid state physics.*




**KEYWORDS:** *Crystal, Crystals, Crystal structure, Magnetism.*

## INTRODUCTION

Crystal structure is a definition of how atoms, ions, or molecules are prepared in a crystalline substance. Ordered structures get up from the intrinsic nature of the constituent particles to shape symmetric patterns which repeat in rely along the primary instructions of three-dimensional space. Atoms are arranged in a 3-dimensional periodic pattern in a crystal, in instantly line. A small portion of the crystal that can be repeated to shape the entire crystal is called a cellular of unit. A unit cell is the constructing block of the crystal shape and also explains the whole crystal shape and symmetry with the positions of the atom at the side of its main axes in detail. The duration, edges of the primary axes and the perspective between the unit cells are known as constants of the lattice or lattice parameters

Figure 1: Asymmetric unit

Figure 2: Primitive unit cell

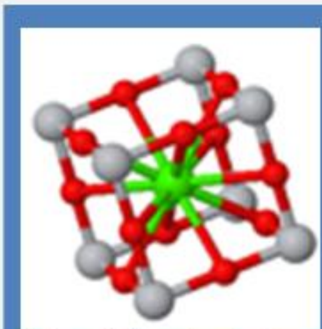


*Figure 3: Conventional unit cell*

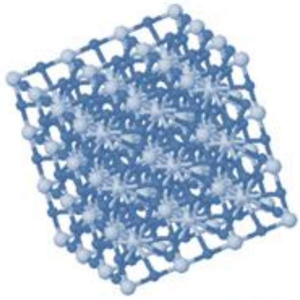


Figure 4: Crystal

The fig. (1, 2,3, 4) shows of gadgets such as stable nation transistors, lasers, sun cells, and light emitting diodes are frequently fabricated from unmarried crystals. Many of the materials are poly-crystaline, which includes maximum metals and ceramics. It implies there are numerous small crystals bundled together where there is random orientation among the crystals. If a cloth's atoms aren't organized in a everyday pattern, it's far called an amorphous substance. Glass is an example of an amorphous substance. This review paper presents the behavior of extra complicating materials typically builds on the understanding that has been obtained by way of analyzing crystals. [1]

## COMMON SEMICONDUCTOR CRYSTAL STRUCTURES

The most popular crystal structure among widely used semiconductors is the diamond lattice shown in (Figure. 5) Each atom in the diamond lattice has a covalent bond with four neighboring atoms forming a tetrahedron together. This lattice can also be constructed from two face-centered cubic lattices, in which one quarter of the body diagonal is displaced along the body diagonal of the larger cube. Consequently, the diamond lattice is a face-centered cubic lattice with two identical atoms as a basis.[2]

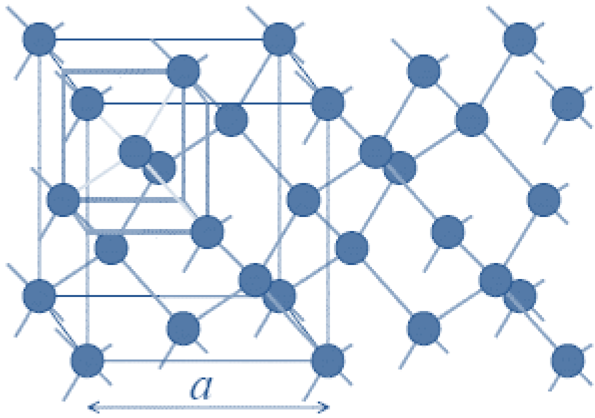



**Figure. 5: lattice of silicon and germanium**

## GROWTH OF SEMICONDUCTOR CRYSTALS

As other crystals, crystals with semiconductors can be obtained by cooling the substance with the molten semiconductor. However, this technique yields poly-crystalline content, as crystals begin to develop with a different orientation at different locations. Instead, one begins with a seed crystal while rising single-crystalline silicone, and dips one end into the melt. The seed crystal grows gradually by regulating the difference in temperature between the seed crystal and the molten silicone. The effect is a big ball of single-crystal silicon. These boules have a cylindrical form, in part due to the rotation of the seed crystal during development and in part due to the cylindrical shape of the melt-containing crucible. The boule is then cut with a diamond saw into "wafers" and further polished to yield the starting material for the fabrication of silicone products.[3]

## CRYSTAL STRUCTURE AND MAGNETISM—

Spinels consist of tightly packed, extremely symmetrical planes of oxygen atoms (something like a densely packed box of marbles) where different metallic elements are trapped in the spaces between them. As a result, a great many different forms of compounds emerge that are used as heat-resistant and magnetic materials in the extractive industries. Embedded metal ions in the spinel system Ni1-xCuxCr$_2$O$_4$ cause distortion of the structure of the crystals. In addition, due to the geometrical structure, they also display magnetic moments which can not be oriented as they would otherwise. As a consequence, incredible new ordering based on temperature emerges. [4-5]

## NEW MAGNETIC PHASES

The magnetic phases occur only in the orthorhombic system, which for pure nickel-spinel as well as copper-spinel lies well below room temperature.[fig-6]

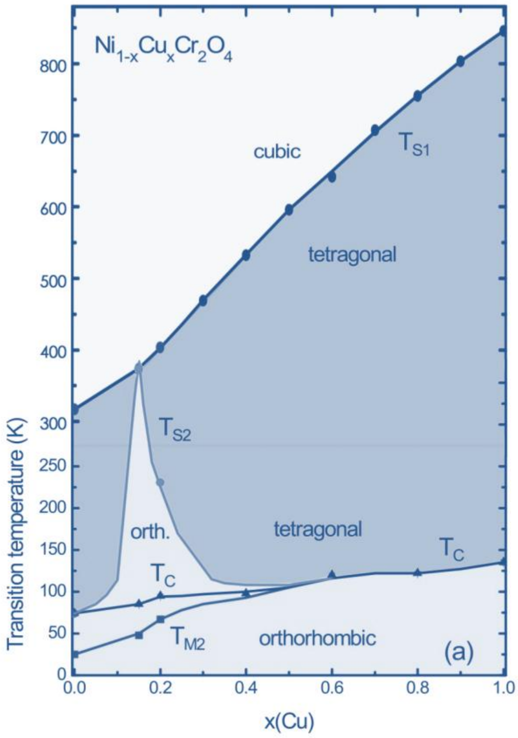



**Figure 6: orthorhombic phase (light blue) magnetic ordering occurs**

## MAGNETISM WITH CRYSTALS:

Magnetic activity arises from the order of the several individual atoms in a substance at the magnetic moments. In helimagnetism, the moments are arranged in a helical pattern instead of the magnetic moments being aligned-as they are in permanent magnets, causing ferromagnetism. This activity is usually only found in complicated lattice structures where different types of magnetic interactions compete with each other, hence the report of induced helimagnetism is highly significant in a simple cubic cobalt oxide structure.[5]

## CONCLUSION

This review article presents the brief idea regarding the crystal structure and magnetism relation how it can be analyzed.

## REFERENCES:


1. PHY.F20 Molecular and Solid State Physics by http://lampx.tugraz.at/~hadley/ss1/crystalstructure/crystalstructure.php

2. Semiconductor Fundamentals by B. Van Zeghbroeck, 2011 Published by Boulder, August 2007
3. H. Nakotteet al., Phys. Rev. B 53, 3263 (1996).
4. M. Reehuis, M. Tovar, D. M. Többens, P. Pattison, A. Hoser, B. Lake. **Competing Jahn-Teller distortions and ferrimagnetic ordering in the geometrically frustrated systemNi1−xCuxCr2O4**. *Physical Review B*, 2015; 91 (2) DOI: 10.1103/PhysRevB.91.024407
5. Crystal structure and magnetism—new insight into the fundamentals of solid state physics by Helmholtz Association of German Research Centres