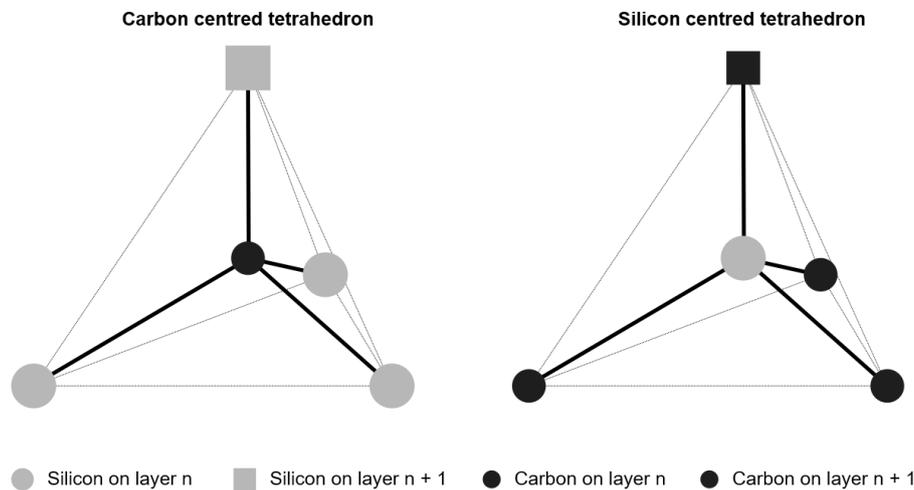


Blog 2, Cubic Silicon Carbide: SiC₃

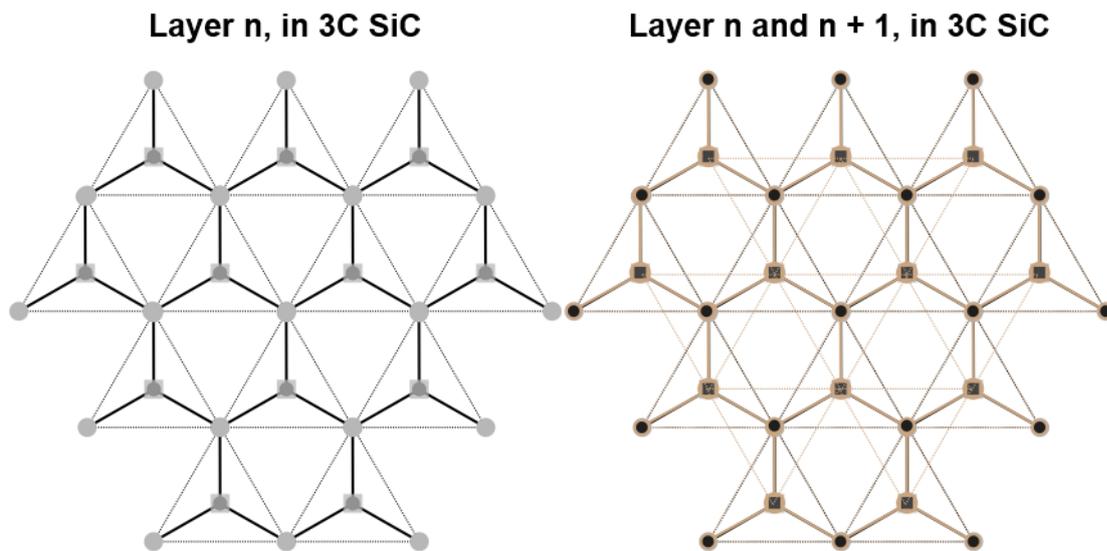
Thermic Edge Coatings (TEC) deposits a high purity silicon carbide coating on various materials. The cubic, SiC³, coating has excellent corrosion protective properties at low, medium and high temperature. Typically the coating finds application in semiconductor industry, LED and solar production and aerospace. Materials coated are graphite, carbon composites, various ceramics and refractory metals.

Silicon carbide consists of 50 % silicon and 50 % carbon and is the stable condensed state under normal conditions. Even though the composition is stoichiometric and simple the structure can vary considerable. Silicon and carbon form a strong covalent bond. The single basic unit of SiC consists of a tetrahedron of either a silicon atom which is bonded to four carbon atoms or either a carbon atom which is bonded to four silicon atoms.



The stacking variation of a layer of single basic units causes the large variation in structure and is referred to as polytypism. It is estimated that over 200 polytypes are possible for SiC. The description of a polytype is based on the number of single basic units to describe the structure and the reference to the crystal symmetry. The description 3C means that 3 single basic units need to be stacked to get a repetition of the cubic structure.

Below is the structure shown in a plane through the centred carbon atoms. The other figure shows the stacking of a layer with centred carbon atoms (layer n) and on top of that a layer of centred silicon atoms (layer n + 1).



Technically there are only a few polytypes of interest which are 3C, 2H, 4H, 6H and 15R where C stands for cubic, H stands for hexagonal and R refers to the rhombohedral crystal symmetry. Due to the variation in crystal structure there is also a variation in physical properties for the various SiC materials. One of the most obvious variation is the electrical bandgap which is also reflected in optical properties and others.

SiC has only one cubic polytype and as the lattice distance is the same in all directions the material is isotropic which means that all properties are the same in all directions. This is the preferred crystal structure of Thermic Edge Coatings and where the name SiC3 related to. The cubic structure is stable up to 2200 °C (at which temperature SiC3 transfers into one of the hexagonal structures) and more importantly small crystals do not grow at elevated temperatures (1500 °C).

SiC3 has a low thermal coefficient of expansion which fits very well to many materials and especially isotactic graphite used extensively in semiconductor industry for wafer support tools and alike. SiC3 has a high uniform thermal conductivity which gives it a very good thermal shock resistance. Both aspects of the coating avoid flaking and chipping of the coating from its base material.