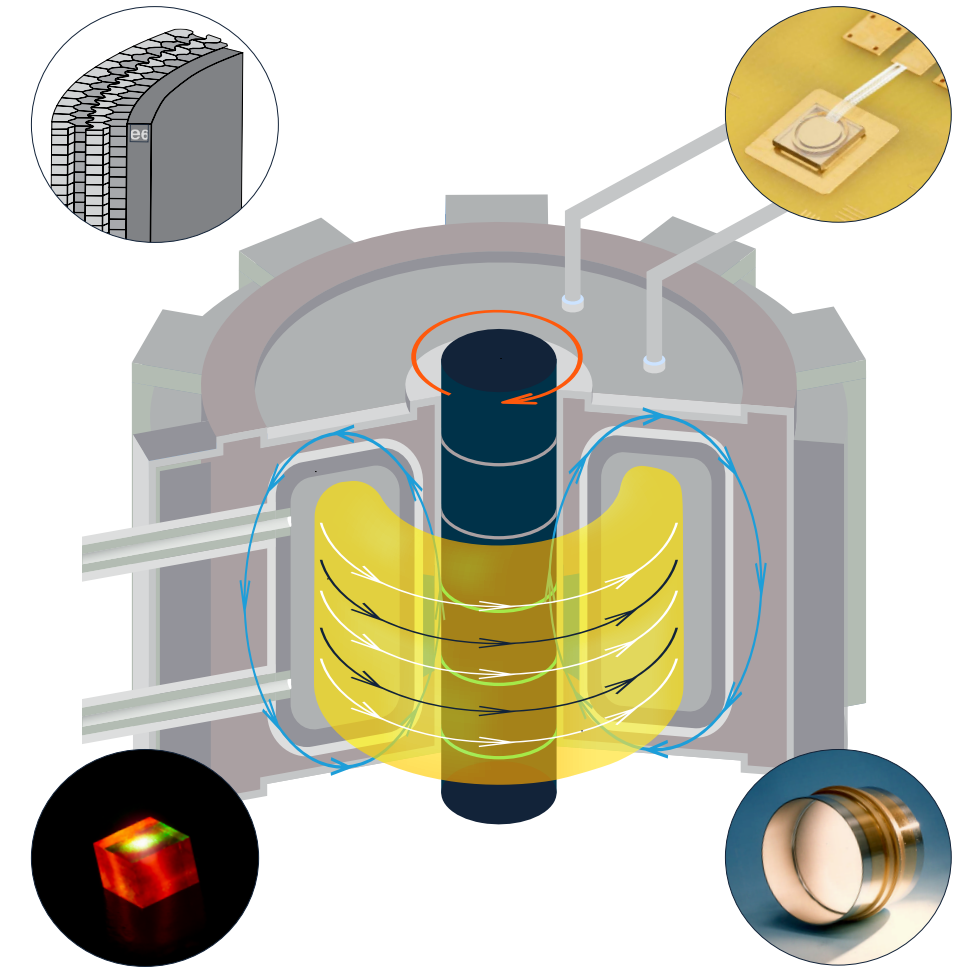
Synthetic diamond & tungsten carbide for fusion

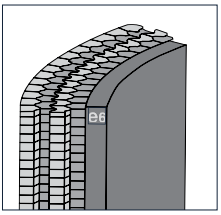
elementSIX™

DE BEERS GROUP



Capable of withstanding extreme conditions of heat and neutron irradiation, synthetic diamond and tungsten carbide are ideal engineering materials for fusion energy.

Tungsten carbide for neutron shielding

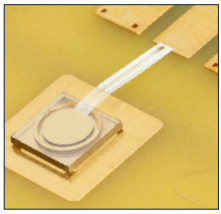


Fusion reactor wall materials must be capable of withstanding extreme conditions of heat, neutron irradiation and fusion plasma interactions. Studies[1] show that tungsten carbide is a highly efficient neutron shield material with superior thermomechanical properties. Element Six's cemented tungsten carbide has been specifically designed for fusion applications, providing effective shielding with reduced activation in high neutron flux environments.

Diamond RF windows for electron cyclotron heating

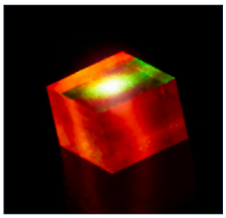
Fusion power plants based on magnetic confinement require megawatt-power electron cyclotron heating systems for plasma heating and control of instabilities. Synthetic diamond's low dielectric loss, stable permittivity and outstanding thermal conductivity make it the ideal material solution for high power RF gyrotron and torus windows.

Diamond fast neutron detectors



For fusion plasma diagnostics such as neutron counting and spectroscopy, diamond is an ideal sensor material. Its radiation hardness, fast response, and high gamma ray and temperature insensitivities, allow diamond detectors to directly identify fast neutrons and distinguish them from the background.

Magnetic field diagnostics



Magnetic field diagnostics are critical for tokamaks and other fusion devices utilising magnetic fields. Magnetic sensors require materials which will not overheat from the fusion plasma radiation, and will survive exposure to neutrons, making diamond magnetometers an ideal candidate

Element Six (E6), part of the De Beers Group, designs, develops and produces synthetic diamond and tungsten carbide advanced material solutions, operating worldwide with primary manufacturing facilities in Germany, Ireland, South Africa, the UK and US.

E6 solutions are used in applications such as cutting, grinding, drilling, shearing and polishing, while the extreme properties of synthetic diamond beyond hardness are opening up new applications in a wide array of industries such as optics, power transmission, water treatment, semiconductors, acoustics and sensors.

Further reading

1. Humphry-Baker SA, Smith GDW. 2019 Shielding materials in the compact spherical tokamak. Phil. Trans. R. Soc. A 377: 20170443
2. https://www.prnewswire.co.uk/news-releases/element-six-synthetic-diamond-protects-cern-particle-detectors-in-recently-announced-higgs-boson-experiment-results-163506746.html
3. https://e6-prd-cdn-01.azureedge.net/mediacontainer/medialibraries/element6/documents/cividec-case-study_12-07-22.

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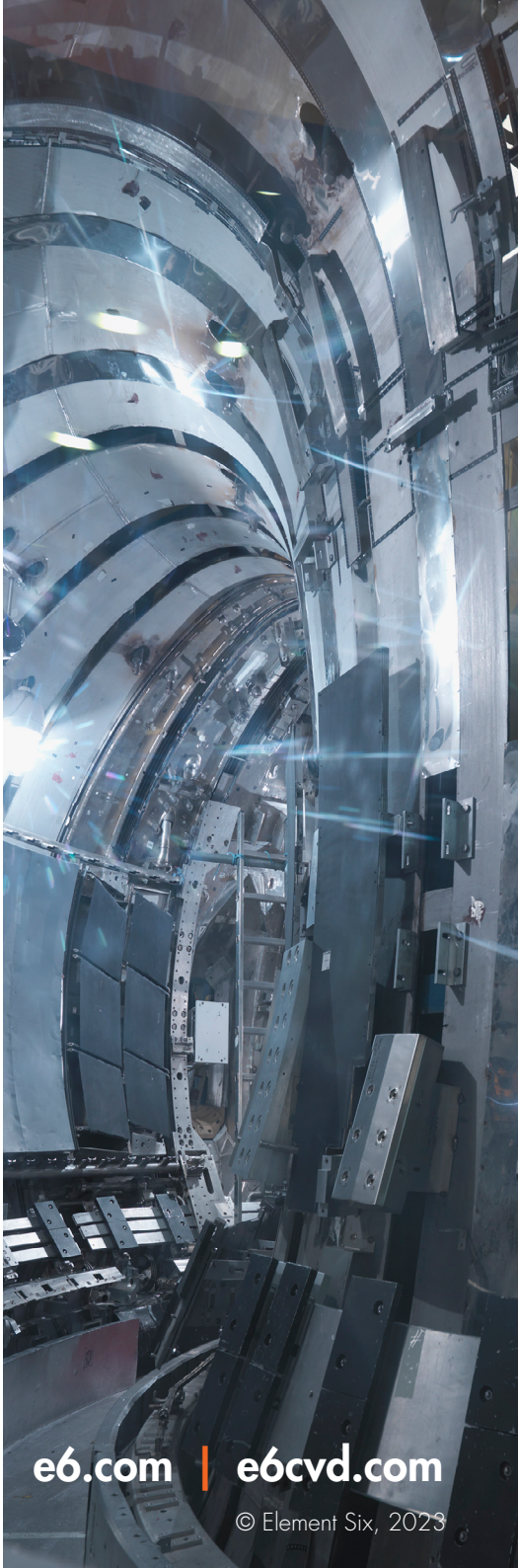

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