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TRISO coated fuel particle research and the economic viability of He cooled Pebble Bed and Molten Salt cooled Reactors

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The characterization of tristructural-isotropic (TRISO) coated fuel particles using transmission electron microscopy has been successfully used in South Africa since 2006. TRISO coated fuel particles are used in high temperature gas cooled nuclear reactors (HTGRs), also called pebble bed reactors. The polycrystalline 3C-SiC layer in the TRISO particle acts as the main barrier to fission product release. The finding, more than three decades ago, that silver (a radioactive fission product) can be released by reputedly intact TRISO nuclear fuel particles has led to significant research efforts to determine the silver (Ag 110m) transport mechanism in SiC. A significant achievement related to the research on high temperature gas cooled reactor (pebble bed) fuel was the discovery by Neethling and co-workers of a transport mechanism of the fission product silver in the SiC layer of a TRISO coated fuel particle.

In this talk the highlights of our research on TRISO particles and metallic fission product transport will be presented. A brief comparison of the technical challenges of He cooled pebble bed reactors and molten salt reactors will be presented. Molten salt reactors (MSRs) have been enjoying increased attention during the past few years due to its many favourable characteristics for nuclear safety, efficiency, cost and sustainability. MSR designs researched include different fuel (U, Pu, Th...) and salt compositions (chlorides, fluorides...). It is hoped that the MSR could increase the sustainability of nuclear power.