

Progress on Development of Helium Tolerant Structural Materials for Fusion Applications

A unique aspect of the fusion environment is substantial production of helium in the materials that confine the plasma. The properties of fusion materials can be degraded by the presence of helium. Excellent progress has been made toward solving this very difficult problem by using novel experimental techniques and advanced computer simulations to better understand and mitigate the degradation caused by large amounts of helium. A unique experimental technique has been developed to study the effects of helium on microstructural evolution under fusion relevant conditions. The surface of a sample is coated with a nickel-bearing alloy. Under neutron irradiation energetic helium atoms are produced in the coating and injected into the sample. These experiments show that a new class of materials, nanocomposited ferritic alloys, offers an effective way to manage helium and mitigate radiation damage. Further, a recently developed advanced multiscale model of helium transport and fate successfully predicted cavity evolution in materials implanted with helium.