Hydrogen Trapping in Graphites and Carbon based Films under Plasma Irradiation

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Graphites and carbon based materials are widely used as a plasma facing components in modern fusion devices. Carbon Fiber Composite (CFC) is chosen for divertor of International ITER. Nevertheless parameters and mechanisms of radiation induced hydrogen retention in graphites and carbon based materials under plasma irradiation are not studied sufficiently.

The paper presents results of experiments performed in gas discharge device perfectly suited for precise measurements of hydrogen trapping in graphites and carbon films under plasma irradiation. The study included investigation of peculiarities of hydrogen trapping in dense graphites, CFC, carbon films in dependence of various irradiation conditions, including impinging ion energy, implantation fluence, irradiation time, plasma density and composition. Number of specific features of hydrogen trapping and release are elaborated and discussed.

In particular, the experiments prove, that trapping of hydrogen molecules from surrounding atmosphere occurs under plasma ion and/or electron activating irradiation. Trapping of molecules takes plays even when energy of impinging plasma particles reaches zero. O₂ and H₂O interaction with graphite as well activate hydrogen trapping.

Hydrogen retention in carbon films was shown to depend strongly on type of substrate. It decreases along with elevation of substrate temperature and increases when residual gas pressure grows. Plasma irradiation does not enhance remarkably the retention capacity of the growing film. Spectra of thermal desorption from the films are very similar to these of dense graphites.

Specific mechanisms of hydrogen trapping in graphite materials and carbon films under plasma irradiation are proposed. Possibilities of elimination of hydrogen retention in graphite materials and redeposited carbon films in tokamak conditions are discussed.