DIAGNOSTIC MIRRORS WITH TRANSPARENT PROTECTION LAYER FOR ITER

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One of the most serious problems for all optical diagnostics in ITER is a fast degradation of in-vessel optics. In the areas remote from confined plasma, in so-called “deposition-dominated conditions”, the major threat to the reliability of optical components stems from the intensive contamination with products of plasma-induced erosion of first-wall elements and divertor tiles. Even thin (dozens of nanometers) and transparent a-C:H films on the mirror surface can dramatically change the shape of the reflectance spectra. In the case of W or Mo mirrors this effect will be added to their rather low reflectance. To minimize negative effect of contamination we suppose to use in the divertor Thomson Scattering (TS) diagnostics scheme high-reflective metallic mirrors (Cu, Ag, Au, Al).

Despite high reflection coefficient, these mirrors have many criteria to meet, and first of all they should withstand high mechanical and thermal stresses. This requirement is a key factor in the choice of substrate material for large-aperture (dozens of centimeters) mirrors used in TS diagnostics. The potential candidate for mirrors blank material should have:

- minimal density and coefficient of thermal expansion;
- maximal thermal-conductivity and modulus of elasticity.

From this point of view, silicon is a very perspective material for mirrors substrate fabrication. Such Si-based large-scale mirrors are successfully exploited in aerospace industry [1] and we believe Si substrates to be well-suited for application in ITER as well.

The thin metallic film on Si-substrate is supposed to be protected from the fast ions sputtering with dielectric oxide layer, i.e., Al_2O_3, ZrO_2, or Ta_2O_5 film [2]. The same protective layer can serve as an antireflection coating for a-C:H films in a limited spectral region. Structure, mechanical and optical properties of dielectric protective films are in the focus of our current research [3].

Our recent results on testing and qualification of high-reflective protected mirrors under the conditions similar to that expected in ITER (high temperature, neutron irradiation, etc) are presented along with our further R&D plans. The problem of mirrors survivability during the repeated cycles of hydrocarbon deposition and plasma cleaning is discussed as well.

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