# §98. Evaluation of Chemical Composition and Retained H and He at Plasma Facing Surfaces of LHD and QUEST

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QUEST, installed in Kyushu University in 2008, is a medium-sized spherical tokamak aiming steady-state operation. Because the plasma-wall interaction is very important for long pule operation, we have been continuously investigated the modification of plasma facing surface by placing probe coupons at many points on the inner wall since 2009.

As shown in Fig. 1, color of inner surface changed year by year due to the interaction with plasma. Especially discolor became stronger after 2010SS, due to the remarkable improvement of plasma performance. In order to know the modification of the plasma facing wall, chemical composition at the surface of Mo coupons placed at the representative positions on the inner wall were analyzed with a glow discharge optical emission spectroscope (GD-OES), (GD-Profiler2, Horiba) installed in Toyama University. Fig 2 shows change of impurity deposition measured at the point A (noted in Fig.1) from 2009SS to 2012AW. This area is a typical example of strong deposition. In each figure, intensity of each element is plotted as a function of Ar sputtering time. Sputtering rate was estimated to be 30-40nm/s. Though the total deposition at each campaign changes, deposition of metallic elements (W, Fe, Cr, Ni) increased remarkably after 2011AW. According to the quantitative analysis with XPS, major components were C and O at the beginning (2009SS, 2009AW), while concentration of Fe and W in 2012AW increased up to 25at% and 16 at%, respectively. In this campaign total deposition is also thick (21nm-thick, estimated by direct observation with TEM). Extensive experiments of long pulse discharges must be the reason for the thick deposition and increase of metallic impurities.

Several melting spots due to the high energy electrons were found on the protection cover of inner stacks made of APS-W coated stainless steels. Similar melting occurred also on the protection cover (stainless steel) fixed on the outer wall. In addition, sputtering erosion of W divertor at the top to the torus were also remarkable. It is considered that these area are the major sources of metallic impurities (Fe, Cr, Ni, W). Though the QUEST is so called "all-metal machine" C deposits always, especially 2010SS and 2010AW. The origin of C has not been cleared yet. However, major source of C at the present would be C deposited wall itself. One should note that deposition of the impurities suppresses well very active retention and desorption of H at the wall temperature range. This would be favorable to keep the particle balance under long operation.

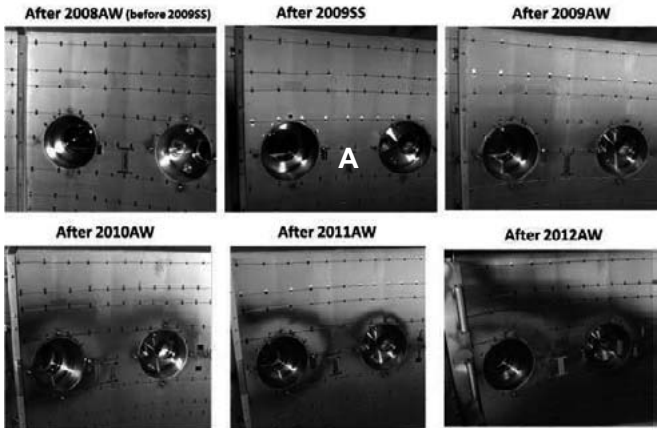


Fig.1 Change of wall color at the equator position

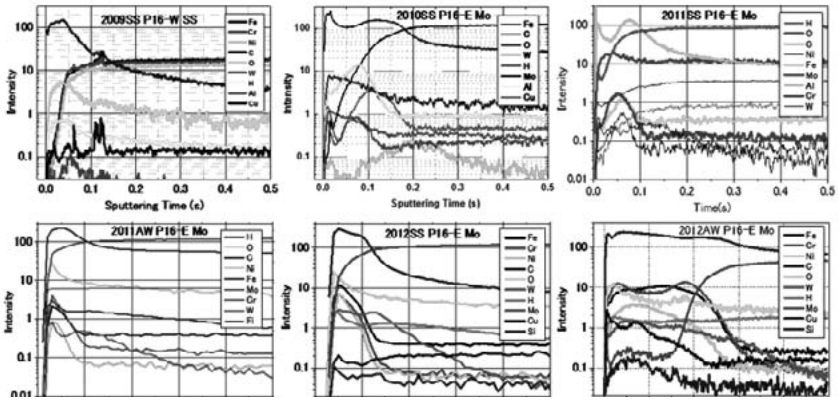


Fig.2 Depth distribution of impurities deposited on the coupon placed at the equator of the wall