Development of Hydrogen Storage Electrode for Plasma Biasing in the Tohoku University Heliac

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In the Tohoku University Heliac (TU-Heliac), the role of a radial electric field on the transition to improved modes has been investigated by electrode-biasing experiments. Especially, by the negative biasing with a hot cathode electrode (electron emission), the radial electric fields can be actively controlled by changing the electrode current I_E, and the local maxima in ion poloidal viscosity were found at the poloidal Mach number $M_p \sim$ -1 to -3 as predicated by neoclassical theory.[1-3]

In the present experiments we adopted hydrogen storage metal as materials for a new type biasing electrode, which has been expected to inject neutral/electron into the plasma by the plasma sputtering. In the TU-Heliac, the high-density plasma was produced ($>10^{19}m^{-3}$) using a titanium (Ti) or vanadium (V) electrode after the hydrogen gas charging in the negative electrode biasing.[4] Specially, with vanadium electrode biasing, the radial distribution of the electron density sloped steeply at the electrode position, and a strong negative radial electric field was formed outside the electrode. The vanadium electrode can produce high-density plasma up to 24 shots per one hydrogen gas charging. However, the vanadium electrode has a disadvantage (hydrogen embrittlement), which causes reduction of hydrogen gas evolution from the electrode surface. Therefore, we developed the new type of a hydrogen storage electrode, which was made of a palladium (Pd) coated with gold (Au). Compared with vanadium, palladium is free from the hydrogen embrittlement. The new type electrode can produce high-density plasma up to ~40 shots per one hydrogen gas charging. Furthermore, the electrode current was controllable in the lower voltage region (V_E = 150~ 200 V).

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