

## **The investigation of the colorimetry to measure the deposition thickness on the plasma-facing wall in QUEST**

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After several campaigns in QUEST, the deposition has been formed on the plasma-facing wall (PFW), which is originally made of stainless steel. The main ingredient is the mixture of carbon and metal such as iron, nickel, chromium, and tungsten. Especially tungsten could come from the divertor and limiter composed of tungsten mono-blocks. The film thickness is the important parameter to understand hydrogen-isotope retention and its recycling property [1]. Its profile in the whole of the PFW should be estimated to understand hydrogen retention and particle balance. To measure the whole profile of the film thickness, an innovative method named colorimetry has been developed, however its application was limited in carbon dominant deposition film [2]. The colorimetry measures the reflectivity on the PFW, which is related with the film thickness and complex refractive index of deposition. Therefore, the complex refractive index of the deposition should be investigated to obtain the film thickness. In QUEST, the complex refractive index was estimated with plasma-exposed samples with the help of the TEM and ellipsometer, and it was quite different from carbon. The film thickness of the PFW measured with the colorimetry agreed with that of the plasma-exposed samples measured with the ellipsometer. This indicates the colorimetry is possible to be applied to the mixed-material deposition as formed in QUEST.

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[1] K. Hanada et al, *Journal of Nuclear Materials* 463, 1084-1086 (2015).

[2] P. Wienhold et al, *Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms* 94, 503 (1994).