Development and manufacturing of the first mirror for H-alpha and Visible spectroscopy in ITER [[1]](#footnote-1)\*)

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Optical scheme of H-alpha and Visible spectroscopy (HA&VS) in ITER includes the mirrors for transmittance of light from plasma to the detectors behind the bioshield. The first mirror faced to plasma will be subjected to significant neutron fluxes, thermal loads, high-energy charge-exchange atoms and redeposition of contaminants from the vacuum chamber and diagnostic duct walls. Development of the first mirror unit design has required selecting of appropriate material selection, developing technology of mirrors manufacturing, developing the systems for mirrors protection against aggressive environment and finally evaluate mirror’s lifetime in ITER conditions. All these goals have been achieved within the procurement contract of the diagnostics units to ITER. Full pack of the mirrors for three HA&VS channels is manufactured and ready for installation to the first mirror units (FMUs).

In this report, a retrospective view on approaches to the different aspects of the first mirror problem is described following ITER project evolution from the beginning to the present day. The modelling and experimental results are presented which have been acquired in NRC KI and other labs where the Specialist Working Group of ITPA (International Tokamak Physics Activity) takes part.

The main attention is paid to the results, which directly relate to the final design and technological solutions. Basing on the simulations of plasma fluxes on the first wall with EIRINE code and on the modelling of neutrals transport over diagnostic channels in Zeemax, a conclusion of domination of the erosion of the first mirror surface over the deposition of the first wall materials was made for all HA&VS channels. The analysis of optical materials properties and experimental data on their physical sputtering lead to selection of single-crystal molybdenum as a first mirror’s material. Such mirror retains acceptable optical parameters even after significant (~1 µm) physical sputtering of its surface that allows using FMU built-in DC discharge cleaning system for recovering the mirror after accidental steam events. The technology of the mirror manufacturing has been developed and qualified. Light-weight sandwich designed mirror prototypes have been successfully tested under ITER-relevant thermal loads.

In conclusion, various organizational and technological problems are presented, which have been met and solved during the manufacturing of the procurement mirror pack following ITER rules.

1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/L/E/ru/IG-Orlovskiy.docx) [↑](#footnote-ref-1)