Large-Scale Collecting Mirrors for ITER divertor thomson scattering [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2023.50.2023.1.1.259

1Tereschenko I., 1Samsonov D., 1Mukhin E., 1Marchiy G., 2Gubal A., 2Mikhailovskiy V., 3Kapustin Yu., 1Koval A., 1Tolstyakov S., 1Snigirev L., 4Komarevtsev I., 5Marinin G., 5Terentev D., 6Gorodetsky A., 6Zalavutdinov R., 6Markin A., 6Bukhovets V., 4Modestov V., 4Kirienko I., 4Buslakov I., 7Chernakov P., 8Mokeev A.

1Ioffe Institute, St.-Petersburg, Russia 2Institute of Chemistry, St.-Petersburg State University, Russia 3Kurchatov Institute National Research Centre, Moscow, Russia
4Peter the Great University, St.-Petersburg, Russia5RUSSIAN TECHNOLOGIES LLC, St.-Petersburg, Russia 6Frumkin Institute, Moscow, Russia 7Spectral-Tech, St.-Petersburg, Russia 8Institution ‘Project Center ITER’ RF DA, Moscow, Russia

Collecting systems for optical diagnostics of ITER retain performance under significant structural, radiation, thermal and other loads. Such systems contain several mirrors and therefore a high reflection of each mirror is required [1]. One of the possible reasons for mirrors degradation of optical surface is accidental steam ingress. In this case in-vessel elements are exposed to a high temperature of more than 90% and more than 240°C.

Silver is known as the most reflective metal in visible and near-IR region. However silver needs to form protective coating, since it interacts with H+ and OH– ions in water vapor [2].

Thin multilayer dielectric coating over Ag layer allows to reduce the rate of Ag degradation. Total protective coating thickness needs about 30 nm to avoid interference. Experiment showed that increase of interface amount in protective coating to 7 layers allowed to suppress corrosion reaction.

The quality of surface polishing stainless steel 316L(N)-IG also affects the reflectivity of mirrors. Abrasive metal polishing leads to the appearance of the disturbed layer with a depth of about 0.3 μm, as well as degradation of the polished surface edges. The most perspective polishing method is magnetorheological finishing (MRF).

Evaluation of the surface quality from the point of view on the use the mirror in the collection optical system of scattered light can be done using mathematical expressions, which is based on the so-called bidirectional reflectance distribution function (BRDF).

This report was prepared as an account of work for the ITER Organization (Rosatom contract N◦ Н.4а.241.19.22.) and supported by Ioffe Institute (Russian Federation state funding assignment 0034–2019–0001).

References

1. Samsonov D.S. et al. Large-Scale Collecting Mirrors for ITER Optical Diagnostic // Nuclear Fusion. 62, 2022. no. 8 p. 086014
2. Folgner K. A. et al. Development and Growth of Corrosion Features on Protected Silver Mirrors during Accelerated Environmental Exposure // Applied Optics. 59. 2020. no. 5. A187
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/L/E/ru/KG-Tereshchenko.docx) [↑](#footnote-ref-1)