Ultraviolet laser induces color centers in ytterbium-doped silica glasses

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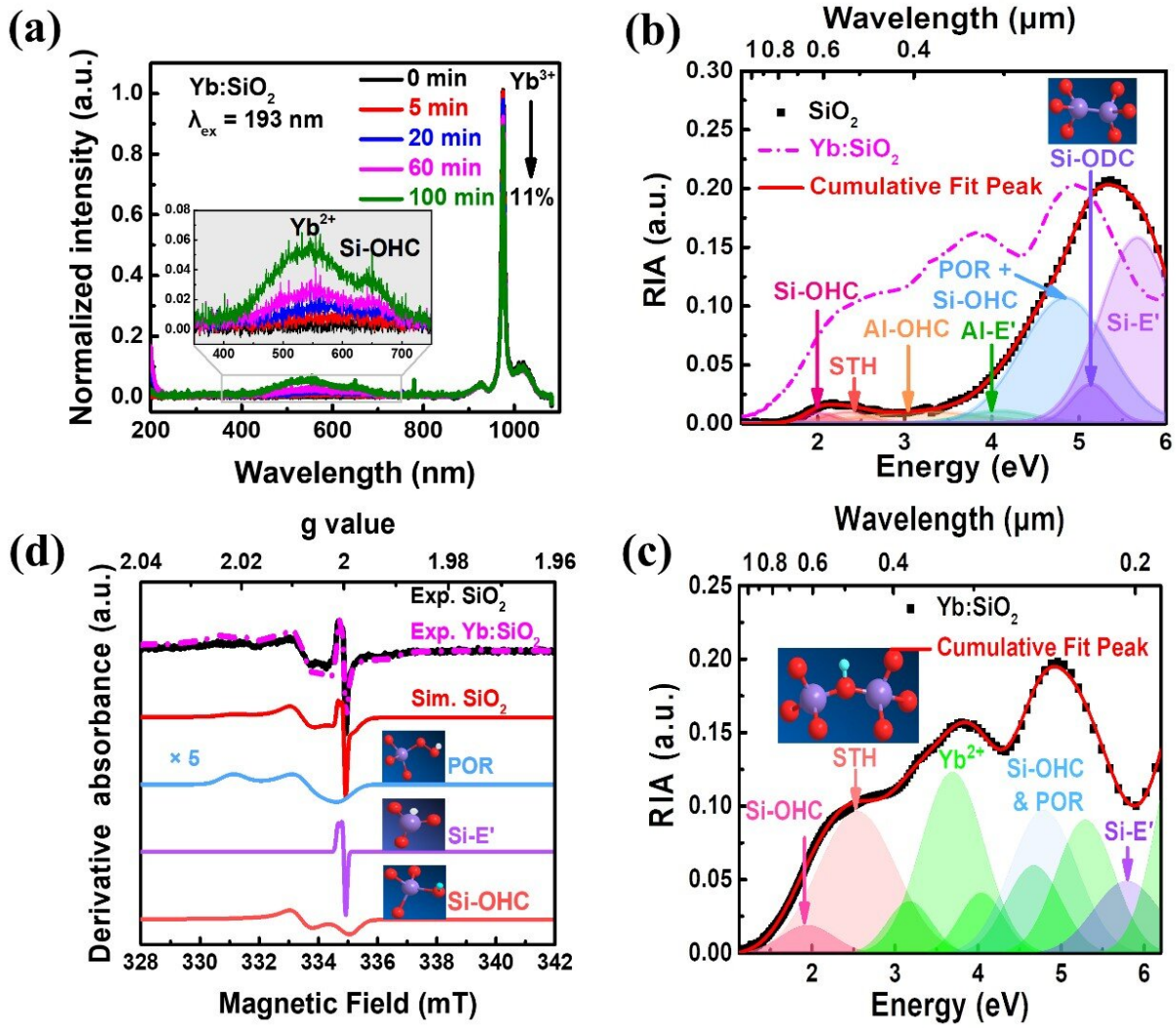

PL, RIA and CW-EPR spectra of YDF core glasses. Credit: SIOM

Ytterbium-doped silica fiber (YDF) has important applications in material processing and scientific research. The photodarkening (PD) effect, which originates from the formation of color centers, can decrease the laser output power over 1,000 h by about 10% and will seriously restrict the power stability of the fiber laser. However, the nature of the PD color centers has not been adequately elucidated until now.

In a recent study, a team from the Shanghai Institute of Optics and Fine Mechanics of the Chinese Academy of Sciences has made a systematic study of PD color centers in YDF. Related work was published in the *Journal of Non-Crystalline Solids*.

In their experiment, a series of YDF core glasses were irradiated with a 193 nm ArF excimer laser for different durations. The species of the UV laser-induced color centers were identified by radiation-induced absorption (RIA), in-situ photoluminescence (PL), and continuous-wave electron paramagnetic resonance (CW-EPR) spectroscopic techniques.

They found that the oxygen hole center and the Yb_2^+ ion pairs were primarily responsible for the UV laser radiation-induced darkening, and their formation was highly dependent on the charge balance between the Yb_3^+ ion and its ligand.

The study also showed that for the Yb_3^+/Al_3^+ co-doped silica glass, the Yb_3^+ ions were surrounded by electronegative $[AlO_{4/2}]$ and electroneutral $[SiO_{4/2}]^0$ groups, and the electronegative $[AlO_{4/2}]$ group favored the formation of the Yb_2^+ and Al-OHC pairs.

More information: Chongyun Shao et al. 193 nm excimer laser-induced color centers in Yb3+/Al3+/P5+-doped silica glasses, *Journal of Non-Crystalline Solids* (2020). DOI: 10.1016/j.jnoncrysol.2020.120198

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