The Effect of Surface Treatment on the Corrosion Behaviour of Austenitic Stainless Steels Exposed to Supercritical Water Conditions.

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Abstract. This contribution reports the corrosion behaviour of stainless-steel samples exposed to supercritical water (SCW) environment. Three different surface conditions, machined (MA), sandblasted (SB), and polished (PO), were used to investigate the effect of surface treatment on corrosion performance in the SCW environment. Two experimental techniques based on positron annihilation spectroscopy were used to characterize the microstructure of the near-surface region. Variable-energy slow positron beam enabled acquiring the experimental data in a depth-profiled manner.

The obtained depth profiles showed a very good correlation between the positron mean lifetime and the Doppler broadening S-parameter (See Fig. 1 a and b), demonstrating the feasibility of using slow positron beam techniques on the characterization of the near-surface region of the stainless-steel samples exposed to SCW conditions. The results show a similar behaviour of the PO and MA samples within the studied range of positron beam energies, corresponding to a probed region up to 1 micron. While no indication of a distinct behaviour was observed in the SB sample prior to the exposure to SCW conditions, both techniques indicate more pronounced corrosion, as compared to the MA and PO samples. In fact, only the SB sample exhibited a negative weight change which suggests the existence of microstructural defects such as microcracks. These can act as diffusion routes for Fe, Ni, and Cr, produce a distinct depletion zone and accelerate the corrosion process. This was indirectly observed by means of positron annihilation methods as an increased concentration of open-volume defects, which also act as positron traps. All investigated samples showed two different corrosion layers, regardless of the surface treatment, which is in agrees with the published literate reporting outer and inner corrosion zones.

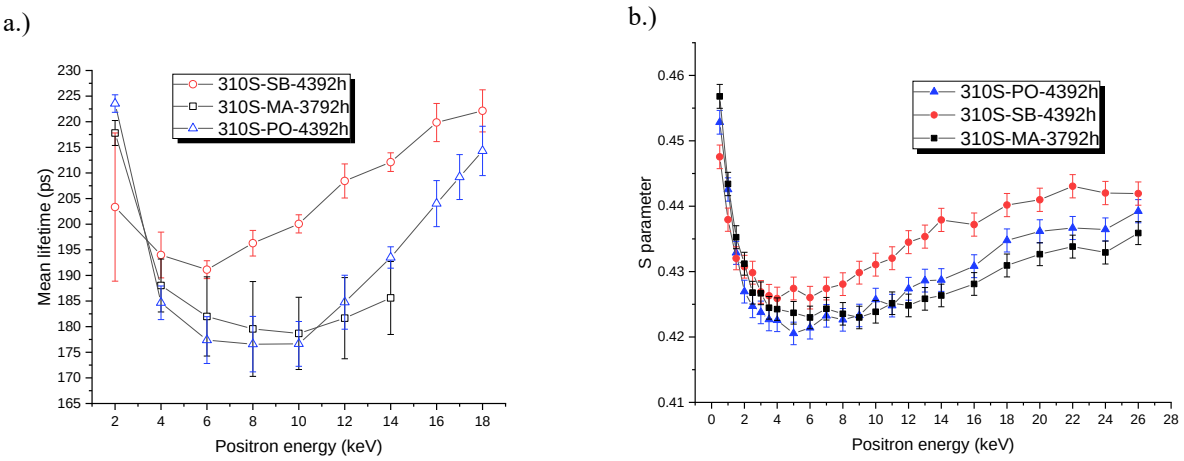

FIGURE 1. Shows the slow positron beam mean lifetime of the SCW-aged samples at the range from 2 keV to 18 keV (a.), corresponding to the positron penetration depth of about 15 – 525 nm. The slow positron DBS data in form of the S parameter are shown in (b.).

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