Corrosion model for T91 grade steel in contact with a heavy liquid metal coolant

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Heavy liquid metal coolants (HLMC), such as lead and lead-bismuth eutectic, are considered as promising candidates for the next generation fast-neutron reactors. However, such coolants form an aggressive environment for the structural materials of the reactor circuits—stimulate active dissolution of steel components and the consequent steel embrittlement. The basic method for steel protection relies on the injection of oxygen into the coolant, which leads to the oxide film formation on the steel surface [1]. Up to date, the corrosion models applied to the reactor conditions were mostly phenomenological and based on the well-known Wagner theory. Such a simplified approach does not allow to account accurately for the effect of temperature and oxygen concentration on the kinetics of oxide film formation. To resolve this issue, we have formulated the adaptation of the Point Defect Model, that was proposed by Macdonald for aqueous environments [2], to the case of HLMC. The relevant set of chemical reactions and the model of electrostatic potential distribution in the oxide film are given [3]. The adapted model demonstrates good predictive ability for the available experimental data on T91 grade steel.

[1] Li N 2002 *Journal of Nuclear materials* **300** 73–81
[2] Macdonald D D 2011 *Electrochimica Acta* **56** 1761–1772
[3] Kolotinskii D A, Nikolaev V S, Stegailov V V and Timofeev A V 2023 *Corrosion Science* **211** 110829