The oxidation behavior of SiAlOC glasses coated ferritic stainless steel in thermal shocks conditions

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Solid Oxide Fuel Cells (SOFCs) are one of the very interesting part of the fuel cell technology. Amongst many other types, SOFCs stand out with high electrical efficiency (60-65%) and energy storage capacity, simple modular structure and production of a low amount of toxic waste along with the application of redox reaction' heat to increase the working efficiency. Unfortunately, some issues concerning the corrosion resistance were observed especially for metallic interconnects (parts separating singular cells in the bigger unit so-called "stack") during their exploitation in an extremely aggressive working environment (800°C; $H_2/H_2O/Ar + O_2$ atmosphere). One of the possible solution to solve this problem is to apply protective-conducting layers, due to the fact that the interconnect is not only responsible for the cells separation but also for their electrical connection and the direct transfer of the produced current to the external receivers [1].

In this work ceramic materials of *v*-SiO_2 structure from quaternary Si-Al-O-C system (sometimes labeled as "black glasses" due to their color) were proposed as a coating material being an interesting alternative to already investigated perovskite- or spinel-based materials [2]. The prominent properties of SiAlOC glasses include high thermomechanical stability up to 1500°C along with chemical and oxidation resistance. They result from both anionic ($O^{2-} \rightarrow C^{4-}$) and cationic ($Si^{4+} \rightarrow Al^{3+}$) substitutions providing respectively with local increase in the density of bonds (Si-C), thereby a strengthening of the glass network, and the flexibility of the material which becomes less vulnerable to the carbothermic reduction phenomena [3].

The main aim of this study was to determine the resistance of SiAlOC glass coating/Crofer 22APU steel system to oxidation in thermal shocks conditions.

The coating material was prepared by applying the sol-gel method, where the introduction of carbon and aluminum ions into the glass network was provided by using alkyl-modified alkoxysilanes (methyltriethoxysilane – MTES and dimethyldiethoxysilane – DMDES) and buthoxyl derivative of Al (Aluminum tri-sec-butoxide). After the synthesis, a part of the sol was thermally treated (70°C, air, 7 days / 800°C, Ar, 30 minutes) and subsequently investigated with XRD, MIR and Raman structural studies in order to confirm the formation of an appropriate material. The second part of the sol was used to deposit thin layers via dip-coating technique. The similar thermal treatment was applied in case of

deposited layers and then, untreated and pyrolized samples were investigated with the oxidation tests in thermal cycles conditions (500 cycles at 800°C in the air for 1h with 45minutes breaks). After that, the structure (XRD, Raman) with microstructure (SEM+EDS mapping analyses) of surface and cross sections of oxidized specimens were evaluated. In the future, the measurements of electrical conductivity by means of the DC 2-point 2-probe technique are planned to supplement the results concerning the oxidation resistance.

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