Influence of Y_2O_3 on microstructural, corrosion, and mechanical properties of ODS steel fabricated by pulse plasma sintering

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Nowadays, nuclear energy is one of the most replaceable energy sources for a broader range of advantages [1]. The very harsh service conditions are the main concern for the development of structure materials in nuclear applications [2]. The oxide dispersion strengthened (ODS) steel is the most promising candidate for fulfilling the desired criteria as structural materials for nuclear applications [3]. The present study uniquely revealed the newly formed microstructure of ODS steel fabricated by pulse plasma sintering (PPS) to establish the ability to work in extremely severe service conditions. The attempt to fabricate ODS steel by PPS could be the most commendable method over other conventional sintering methodologies.

In this research, we produced austenitic ODS austenitic steels with Y_2O_3 addition. The ODS steel powders were produced using different mechanical alloying parameters: duration of 5, 10 and 50 hours of milling at 250 rpm in Ar atmosphere. The influence of 1 wt.% of Y_2O_3 on the fabrication of ODS steel by PPS has been investigated in terms of microstructure, mechanical properties and corrosion resistivity. Microstructure has been evaluated by SEM, EDS, XRD and EBSD, mechanical test were made using an uniaxial tensile test, while corrosion resistance was evaluated based on electrochemical tests

The microstructural study revealed that the properties of the produced materials depends on the mechanical alloying conditions. The highest tensile strength was achieved after mechanical alloying during 50 h, while the lowest after 5 h of mechanical alloying. The highest elongation was measured after 5 hours of powder milling. It may be supposed that a fine and uniform distribution of oxide particles helps to resist corrosion in ODS steel as compared to coarse grains formed after shorter milling times.

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