Ref.: IIIj09-004

Study of ODS formation by ion-beam implantation of Al+ and O+ on the AISI 316L steel and this influence in the He bubble grown

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Resumo:
A class of materials namely oxide dispersion strengthened (ODS) steels has been studied as structural materials for IV generation fission reactors and fusion reactors. The ODS shown to be effective in changing mechanical, thermal properties and resistance to swelling at high temperatures due to the greater thermal stability of the oxides combined with the insertion of new interfaces that serve as a vacancy trap and displacement fixation points. In this work the ion-beam implantation of Al+ and O+ was applied by the ion-beam synthesis to synthesize ODS in AISI316L austenite steel that is an important structural material for the fusion and fission reactors considering the corrosion resistance at high temperatures. Also is present a preliminary study of nucleation and growth of He bubbles in the way to simulate the swelling process and this behavior under the presence of the oxide dispersions. The samples were characterized by TEM, SAED and STEM-EDX techniques. SAED and EDX measurements show that the precipitates formed in samples implanted only with O and in samples implanted with Al and O are chromium oxide. Furthermore, STEM-EDX analyses show that no Al signal was observed neither in the precipitates nor in the matrix. The oxide precipitates are formed during the implantation procedure, with no need to undergo thermal activation processes. The Al implantation participates in second phase precipitation, acting in the production of vacancies during implantation and consequently enhancing the nucleation rate of the ODS. Temperature effects were also assessed in this study. At 550 ºC the influence of temperature in the thermodynamics of the system is few prominent, with precipitates and He bubbles' sizes remaining quite stable. In other way, at 700 ºC is observed a drastic change in the geometry of the precipitates that become faceted in coherent interfaces whit the austenitic matrix. Regarding the He bubble system, it was observed lower tendency of growth in the samples containing the ODS. So, the oxide particles produced by ion-beam synthesis are an efficient way to hinder the growth of the inert gas bubbles, indicating a possible way for the study of the swelling process in the AISI316L.