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Tribological and microstructural assessments of austenitic stainless steels during microscratch tests

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Austenitic stainless steels are frequently applied to mechanical systems due to their suitable properties of corrosion resistance, and ferromagnetism absence. The design of materials focused on stainless steels can be developed with regard to, for example, their machinability, material removal mechanisms, and strain hardening aspects. Moreover, tribological tests conducted at the microscale are promising to investigate the microstructural behavior of the inclusions and their features by analyzing the local effects along the wear track. In this respect, the objective of this work was to assess the influence of MnS particles on the austenitic matrix during microscratch tests, studying the abrasion responses of AISI 303 and 304 steels. Experimental tests were carried out, considering a diamond conospherical tip with 10 um diameter that scratched the steel. Constant normal loads of 40, 50 and 60 mN were established throughout the trials. Scanning electron microscopy (SEM) was applied to investigate the material removal mechanisms. Local results were provided with regard to the friction coefficient, material removal and specific energy. The local effect of MnS was mainly evidenced regarding fluctuations in specific energy along the track, when compared with that of the austenitic matrix. SEM micrographies indicated the regions where micro-ploughing and cutting were prevailing. In addition, Finite Element Method modeling was implemented in this analysis, which corroborated the experimental findings, and allowed a more detailed evaluation of the energies and abrasive micromechanisms. In turn, the development of additional tensile tests allowed pointing out the inclusion influences in the AISI 303 steel, which presented higher mechanical resistance and lower ductility with respect to the AISI 304 steel.