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EVALUATION OF MECHANICAL PROPERTIES OF INTERFACES BY FEM SIMULATION OF THE INSTRUMENTED INDENTATION TEST

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The interface adhesion of coatings can be evaluated by the fracture toughness according to a relationship that takes into account the Elastic Modulus - Ei and Hardness – Hi of the coating-substrate interface. Chicot et al. (1996) had used a physical model of the interface where Ei/Hi are given as a function of the mechanical properties of the substrate and coating: Es, Hs, Ec, Hc. However, the accuracy of the physical model is not known. In this work we use the Finite Element Method to simulate instrumented indentation tests in the interface between two different materials. A set of 16 different combinations of materials (4 substrates and 4 coatings) was simulated by using DEFORM software. The simulations have provided force-displacement curves of load-unload cycles that were analyzed applying the Oliver-Pharr method (1992) by using DUREZA software (Shuman et al. 2007). The results showed that the strain distribution around the interface can be very different from the ideal. It was found deviations between -12 and 20% depending on the difference between the mechanical properties of the materials. However, these values were for the extremes, the most simulations presented deviations from the model around -5%. It can be concluded that in general the model underestimates the quantity Ei/Hi, but overestimation takes place in some cases, which shall be took into account in designing of coated mechanical components.