6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11 – 15 June 2018, Glasgow, UK

EXPERIMENTAL AND NUMERICAL INVESTIGATIONS TO ASSESS THE INTERFACIAL STRENGTH OF THE ULTRATHIN COATINGS ON POLYMERS SUBSTRATES

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Key Words: *Nano coating, Polymer substrate, interfacial strength.*

Metal coating with a nanometer scale thickness on flexible polymer substrates is an interesting combination for food packaging applications. This combination provides an enhancement of the barrier performance in the carton package [1, 2]. A concern is the cracking of the brittle coating when subjected to tension and bending in the manufacturing process. Such cracks can affect the permeability. In this study, the coatings were produced by atomic layer deposition of metal oxides, with thickness values between 4 and 20 nanometers on poly(ethylene terephthalate) substrate films.

The interfacial strength between coating and substrate is known to affect the crack formation. We have used an experimental technique known as the Fragmentation test (see e.g. Ref. [3]) and an analytical model to quantify the interfacial strength. The fragmentation test was performed by *in situ* tensile loading in a scanning electron microscope stage to track the crack accumulation and subsequently to calculate interfacial shear strength. As the scanning electron and atomic force microscopy is becoming easier to use and more cost efficient, increased local information on crack geometry can be obtained. In this work, we explore a mixed numerical-experimental method to quantify the interfacial strength based on observed delamination emanating from coating cracks, as schematically outlined in the figure. The results from this alternative method are compared with those from the more established fragmentation test. The advantages and disadvantages of the two methods are discusses, as well as the accuracy of the assumptions in their underlying models.

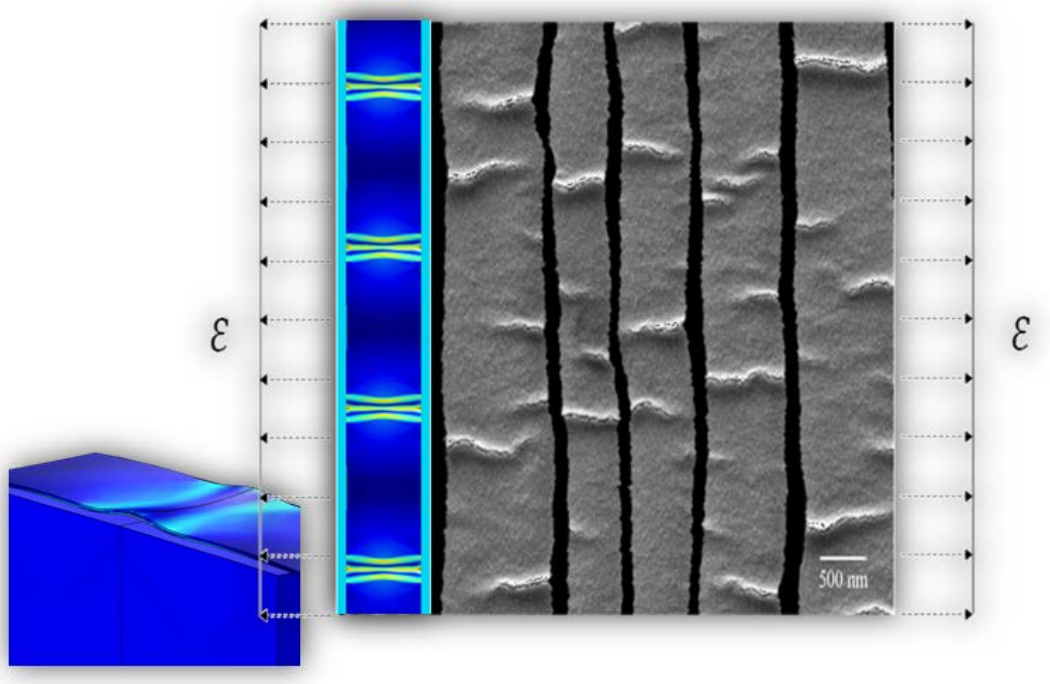

Fig. 1: TiO_2 coating of 6 nm thick on top of PET film stretched at 30% tensile strain.

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