Micro-Mechanism of Laminated Packaging Material during Fracture

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In food package technology, Aluminum foil (Al-foil) has been used as an efficient barrier to oxygen and light. In many applications, the foil is coated with a polymer layer. The packaging material is exposed to various loads during filling, forming, distribution and storage. This leads to small cracks that are often be found initiated in the Al-foil layer and then propagate to other layer or between the layers. To predict and simulate this behaviour, it is proposed that fracture analysis of each layer and their lamination need to be performed.

In this work, fracture path of a fully annealed Al-foil (fully annealed, temper O alloy 1200, about 6-9 μm), which is widely used in aseptic liquid food packaging, is followed in Electron Microscope and Scanning Electron Microscope. Single Edge Notched Tension specimens (SENT) with length of 8 mm, height of 4.5 mm and V-notch of 1 mm are used. The crack length and applied load were measured during crack initiation and growth. The specimens' cross section were then studied using the optical profilometric method to exam the deformed surface. For the uncoated Al-foil, no fracture surface can be observed. Fracture seems to occur through so-called necking. This behaviour was successfully modelled by a modified strip yield model [1] theoretically. A conclusion can be get that the crack tip is preceded a substantial plastic zone as compared with the crack length [1]. The result was then compared to a polymer coated Al-foil, which leads to several interesting results and a prediction by using finite element method [2-3]. Further more, similar experimental works were performed on a polymer coated and uncoated Polypropylene. The results were discussed and compared to the cases with Al-foil layer.

References

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