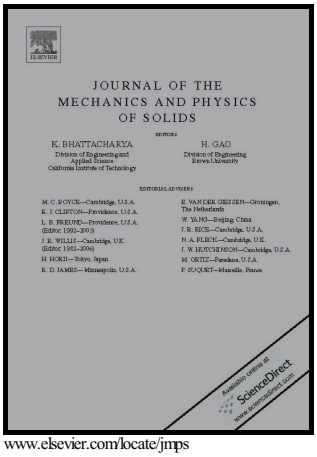

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Michael Nase, Mirko Rennert, Konstantin Naumenko, Victor A. Eremeyev

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Identifying traction-separation behavior of self-adhesive polymeric films from in situ digital images under T-peeling

Michael Nase[a], Mirko Rennert[b], Konstantin Naumenko[c,*], Victor A. Eremeyev[d]

[a] *University of Applied Sciences Hof, Faculty of Engineering, D-95028 Hof, Germany*
[b] *Martin-Luther-University Halle-Wittenberg, Center of Engineering Sciences, D-06099 Halle, Germany*
[c] *Otto-von-Guericke-University Magdeburg, Institute of Mechanics, D-39106 Magdeburg, Germany*
[d] *Rzeszów University of Technology, Faculty of Mechanical Engineering and Aeronautics, 35-959 Rzesz ów, Poland*

Abstract

In this paper procedures are developed to identify traction-separation curves from digital images of the deformed flexible films during peeling. T-peel tests were performed for self-adhesive polymeric films. High quality photographs of the deformed shape within and outside the zone of adhesive interaction were made in situ by the digital light microscope. The deformed line is approximated by a power series with coefficients computed by minimizing a least squares functional. Two approaches to identify the traction-separation curve for the given deformation line are proposed. The first one is based on the energy integral of the non-linear theory of rods and allows the direct evaluation of the adhesion force potential. The second one utilizes the complementary energy type variational equation and the Ritz method to compute the adhesion force. The accuracy of both approaches is analyzed with respect to different approximations for the deformed line and the force of interaction. The obtained traction vs. axial coordinate and the traction-separation curves provide several properties of the adhesive system including the maximum adhesion force, the length of the adhesive zone and the equilibrium position, where the adhesive force is zero while the separation is positive.

Keywords: Self-adhesive film; Traction-separation curve; T-peel test; Work of adhesion

1. Introduction

Adhesive systems of flexible films are widely used in multifunctional layered components. Examples include flexible OLED and PLED devices [5, 6, 44], photovoltaic laminates [9, 10, 30, 38] and polymer film packages [27, 28]. For analysis of structural integrity of such components it is beneficial to determine the forces of interaction and the work of adhesion between individual flexible layers or flexible layers and stiff substrates. Material saving and film down-gauging might

*Corresponding author
Email addresses: michael.nase@hof-university.de (Michael Nase), mirko.rennert@iw.uni-halle.de (Mirko Rennert), konstantin.naumenko@ovgu.de (Konstantin Naumenko), eremeyev.victor@gmail.com (Victor A. Eremeyev)