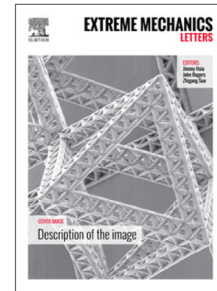


## Accepted Manuscript

Extended Hencky solution for the blister test of nanomembrane

Yong Ma, Guorui Wang, Yuli Chen, Deng Long, Yingchun Guan, Luqi Liu,  
Zhong Zhang



PII: S2352-4316(18)30098-1  
DOI: <https://doi.org/10.1016/j.eml.2018.05.006>  
Reference: EML 372

To appear in: *Extreme Mechanics Letters*

Received date: 8 May 2018  
Accepted date: 26 May 2018

Please cite this article as: Y. Ma, G. Wang, Y. Chen, D. Long, Y. Guan, L. Liu, Z. Zhang, Extended Hencky solution for the blister test of nanomembrane, *Extreme Mechanics Letters* (2018), <https://doi.org/10.1016/j.eml.2018.05.006>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

## Extended Hencky solution for the blister test of nanomembrane

Yong Ma<sup>1</sup>, Guorui Wang<sup>2</sup>, Yuli Chen<sup>1,3,\*</sup>, Deng Long<sup>1</sup>, Yingchun Guan<sup>4</sup>, Luqi Liu<sup>2,\*</sup>,  
Zhong Zhang<sup>2,\*</sup>

<sup>1</sup> Institute of Solid Mechanics, Beihang University, Beijing 100191, P.R.China

<sup>2</sup> CAS Key Laboratory of Nanosystem and Hierarchical Fabrication, CAS Center for Excellence in Nanoscience, National Center for Nanoscience and Technology, Beijing 100190, P.R.China

<sup>3</sup> Department of Civil and Environmental Engineering, Northwestern University, Evanston, IL 60208, USA

<sup>4</sup> Sch Mech Engn & Automat, Beihang University, Beijing 100191, P.R.China

### Abstract

The blister test has been extensively used as a simple and effective approach to measure the elastic modulus and the interface adhesion energy of two-dimensional nanomembrane. However, the conventional blister test model is commonly based on the Hencky solution in which the clamped boundary is assumed without consideration of sliding, and consequently, it can hardly obtain the stress distribution outside the blister region. Therefore, in this paper, the clamped boundary condition is removed, and the Hencky solution is extended based on the Lamé solution to account for both the sliding displacement and the stress and strain fields outside the blister region. The expression of the extended Hencky solution is as simple as the original one, but it provides a more accurate description for both the blister configuration and the stress and strain fields of nanomembrane, which are proved by molecular dynamics (MD) simulations of graphene blister test. Our theoretical model is further validated by the experimental results regarding the blister test of a monolayer graphene membrane, where a higher accuracy can be observed in the interpretation of the data.

**Keywords:** Hencky solution, blister test, adhesion energy, graphene, two-dimensional nanomaterials

---

\* Corresponding authors. E-mail address:

yulicheng@buaa.edu.cn (Yuli Chen), liulq@nanoctr.cn (Luqi Liu), zhong.zhang@nanoctr.cn (Zhong Zhang).

Download English Version:

<https://daneshyari.com/en/article/7170569>

Download Persian Version:

<https://daneshyari.com/article/7170569>

[Daneshyari.com](https://daneshyari.com)