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Title	Prediction of strain energy on photo-resist patterns
Researchers	Masahiro Noda, Makoto Sasaki, and Masao Doi
Purpose of this study	Prediction of strain energy on cantilever supposing photo-resist pattern
System (Material)	Photo-resist (Polymer thin film)
Program (including analysis)	MUFFIN ver.2 (MSPD)
Method & Some important input parameters	(Method) Calculation and analysis of strain and strain energy by linear elastic theory (Inputs) Elastic modulus of polymer thin film(bulk modulus and shear modulus), stress
Advance & Problem	(Advance) - We succeeded to calculate the strain energy distribution on photo-resist pattern. - Critical aspect ratio which is hard to be determined by experiment can be predicted by the analysis. (Problem) - estimation of elastic modulus of polymer thin film and stress
References	[Manuscript] Submitted/Accepted(/) [Presentation at conferences (Meetings)]
KeyWords (in English)	photo-resist, bulk modulus, shear modulus, Young's modulus, strain energy

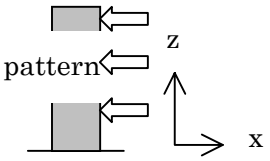
Results (Remarks)

Output: strain, strain energy etc.
Analysis: aspect ratio of resist pattern

[Example of analysis]

Input parameter

-Elastic modulus
G=1.72(GPa)
K=16.7(GPa)
(E=5.00(GPa))



-Stress
-500(KPa) perpendicular to x_max plane (z_min plane is fixed.)

Method

-The maximum strain energy is computed, with changing pattern form (Fig. 1).

-The critical aspect ratio for the collapse (Ac) can be determined from the relation between the aspect ratio and the energy with the critical strain energy(Ec) (Fig. 2).

Results

-The critical collapse aspect ratio was obtained for the photo-resist pattern 0.1μm or less (Fig. 3).

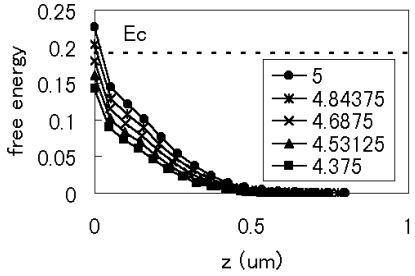


Fig.1 Height dependence of the strain energy, changing the aspect ratio (pattern width: 0.16μm, z: 0.7-0.8μm).

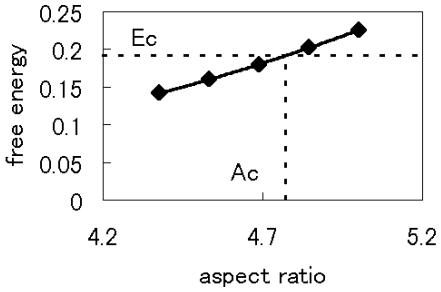


Fig.2 Relation between the aspect ratio and the maximum strain energy (pattern width: 0.16μm).

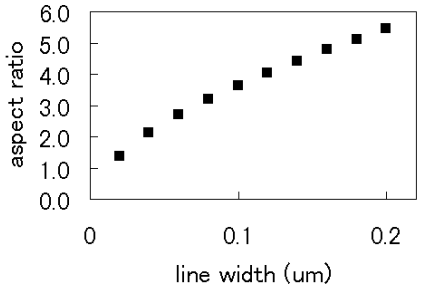


Fig.3 Relation between line width and a critical aspect ratio.