

## Pressure area isotherms for elastic interfaces

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### Abstract

Monolayers of surface active molecules or particles play an important role in biological systems or in consumer products, their functioning being controlled by their thermodynamic and mechanical properties. For insoluble species forming so-called Langmuir monolayers, surface pressure-area isotherms are measured to characterise the thermodynamic state. Typically a Langmuir trough equipped with a Wilhelmy plate is used. However, when these interfaces are compressed and become more and more structured, the elastic response of the interfaces interferes with the measurement. Recent reports of compression data for highly elastic interfaces revealed a dependence of the apparent surface pressures on the geometry. In the present work, this dependence is rationalised by considering adequate constitutive models. As the deformations in compression experiments are large, linearised versions of the Kelvin-Voight model do not suffice. Rather, a framework for quasi-linear constitutive models is developed by choosing suitable non-linear strain tensors, adequately separating the shear and dilatational effects in a frame invariant manner. The geometry dependence is then shown to be a consequence of difference in the deformation state of the interface, with varying contributions of the isotropic surface pressure and the deviatoric shear and dilatational elastic stresses. An algorithm is then proposed to obtain the intrinsic surface pressure-area isotherms for elastic interfaces.