Second-strain gradient elasticity for chemo-mechanical couplings

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Abstract :

It is well established that downsizing mechanical structures make their surface-over-volume ratio much larger than for usual objects, so that their ability to interact with their environment is significantly augmented. This has been particularly used in the development of cantilever sensors, where a surface energy change on one side induces the cantilever's bending. Even though this phenomenon has been implemented for a wide range of molecules, the modeling the mechanical response of a micromechanical structure to a surface energy change has been scarcely investigated. Second-strain gradient elasticity has been shown to naturally involve the equivalent of surface tension for solids, and thus seems particularly suited to model the deformation of solids subjected to a surface energy change. A toy model is first used to demonstrate the key role of the material in the chemo-mechanical transduction, thereby stressing the need for an adequate experimental identification procedure.

The higher-grade framework also points to a specific mechanical quantity enabling the control of the surface energy of the materials. This will be detailed together with the corresponding experimental approach.