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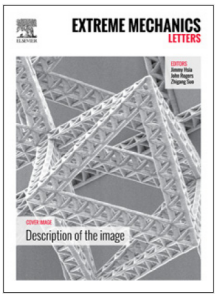

The elastic fields of a compressible liquid inclusion

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The elastic fields of a compressible liquid inclusion

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Abstract: Elastic composites containing liquid inclusions exist widely in rocks, food, tissues and hydrogels. We investigate a single ellipsoidal compressible liquid inclusion embedded in an infinite elastic matrix, such as an isolated cell embedded in an extracellular matrix and oil or gas pocket embedded within shale. We first derive the displacement and stress fields in the matrix under far field loading. For the special case of a spherical inclusion, we arrive at simple, explicit expressions for these fields. We next focus on the shape evolution of the liquid inclusion and the stress concentration in the matrix, from which we conclude when the effect of liquid compressibility is most significant. Finally, we classify common examples of liquid inclusions in nature and engineering. According to our theoretical results, we estimate the importance of liquid compressibility in these examples and provide guidelines for further application of the theory of liquid inclusions in practical situations.

Keywords: liquid inclusion, liquid compressibility, inclusion theory, solid-liquid interaction

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