Supplementary Information

Negative Poisson's Ratio in 2D Life-boat Structured Crystals

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The calculation about the rotation and stretch of the bonds

The bond rotation and stretch happen simultaneously in a strain-engineered process. To estimate the energy change dominated by only rotation or stretch effect, a rigid approach can be used by fixing the other variables but relaxing those expressing the rotation or stretch. To compare the $\frac{\partial U}{\partial r}$ and $\frac{1\partial U}{r\,\partial \theta}$, the limit definition of partial derivative can be used:

$$\frac{\partial U}{\partial r} = \lim_{\Delta r \to 0} \frac{\Delta U}{\Delta r}|(\theta,\varphi)$$

$$\frac{1\partial U}{r\,\partial \theta} = \frac{1}{r}\lim_{\Delta \theta \to 0} \frac{\Delta U}{\Delta \theta}|(r,\varphi)$$

The ratio of $\frac{\partial U}{\partial r}:\frac{1\partial U}{r\,\partial \theta}$ in δ-phosphorene, δ-arsenic and δ-graphene under strain in the armchair direction are approximately 5:1, 2.2:1, and 1.2:1, respectively.

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