Can the collective emission of the excited surface phonon trigger low-energy nuclear reactions?

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Low-energy nuclear reaction (LENR) in condensed matter is a very challenging topic due to the complex control parameters to reproduce the experiments, and the remarkable impact to human society. The resonant tunnelling optical model with coupled complex potentials [1] is very interesting due to its simplicity and interoperability. The model includes a complex Coulomb barrier with a positive real part and negative imaginary part, coupled with a complex nuclear well with a negative real part and positive imaginary part. Physically, the positivity in imaginary part denotes the absorption nature, and the negativity in imaginary part denotes the emission nature. However, it is very hard to understand for emission nature of Coulomb barrier.

Here, we proposed a hypothesis of coherent emission of the excited surface and/or sub-surface atoms contributed to the negative imaginary part of Coulomb barrier, and then to the origin of LENR. Typically, excited surface phonons are incoherent due to the random inter-atomic collisions. The possible factor is to locally excite the surface phonons and result in the Bose-Einstein condensation. In particular, the localized anharmonic vibrations proposed by Dubinko et al might be one of the possible ways to realize the localized excited coherent surface phonon [2]. We calculate the phonon band structure of PdH and PdD by considering the anharmonic vibrations, and try to bridge the gap of the localized anharmonic vibrations and the emission nature of surface phonons. The proposed mechanism might be useful for understanding some LENRs triggered by thermal heating, THz pumping, gas pumping or inflating, etc.

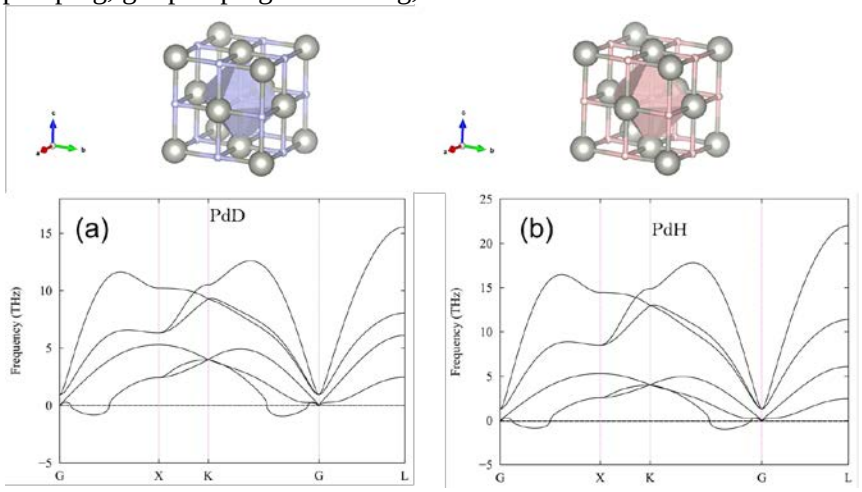

Figure 1. Anharmonic phonon spectra calculated for PdD (a) and PdH (b).

References

[1] X.Z. Li, Q.M. Wei, B. Liu, “A new simple formula for fusion cross sections of light nuclei”, Nucl. Fusion, vol. 48, pp. 125003-125007, 2008.

[2] V.I. Dubinko, D.V. Laptev, “Chemical and nuclear catalysis driven by localized anharmonic vibrations”, Lett. Mater. vol. 6, pp. 16‑21, 2016.