
缓慢压缩的高熵合金纳米柱中的位错雪崩机制

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论文标题：Dislocation avalanche mechanism in slowly compressed high entropy alloy nanopillars

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缓慢压缩的高熵合金纳米柱中的位错雪崩机制。最近《通讯-物理学》发表的一项研究Dislocation avalanche mechanism in slowly compressed high entropy alloy nanopillars通过将电子成像和机械测量结合起来研究位错雪崩机制。

晶体会因位错的间歇性增殖和滑移雪崩而变形。位错增殖已经被研究的比较清楚，但是雪崩背后的形成机制尚不清楚，而且缺乏普适性的论点导致了关于晶体塑性有很多细节混乱且具争议的意见。

来自伊利诺伊大学香槟分校材料科学与工程学系的Jian-Min Zuo及其研究团队，他们通过直接的电子成像技术和精确的机械测量手段，跟踪了高熵合金Al_{0.1}CoCrFeNi压缩纳米柱中的位错雪崩进程。结果表明，雪崩起始于位错堆积和位错带的形成。位错堆积形成在位错带前面，它的释放会触发雪崩，就像打开了一道水闸门。纳米柱中位错雪崩的大小在几纳米到100纳米之间，其幂律分布类似于地震。因此，该研究识别了大晶体滑移的位错相互作用机制，并对高熵合金的变形提供了关键性见解。

摘要： Crystals deform by the intermittent multiplication and slip avalanches of dislocations. While dislocation multiplication is well-understood, how the avalanches form, however, is not clear, and the lack of insight in general has contributed to a mass of details and controversy about crystal plasticity. Here, we follow the development of dislocation avalanches in the compressed nanopillars of a high entropy alloy, Al_{0.1}CoCrFeNi, using direct electron imaging and precise mechanical measurements. Results show that the avalanche starts with dislocation accumulations and the formation of dislocation bands. Dislocation pileups form in front of the dislocation bands, whose giveaway trigs the avalanche, like the opening of a floodgate. The size of dislocation avalanches ranges from few to 102 nm in the nanopillars, with the power-law distribution similar to earthquakes. Thus, our study identifies the dislocation interaction mechanism for large crystal slips, and provides critical insights into the deformation of high entropy alloys.

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