CONTROLLING PLASTIC FLOW IN BRITTLE STRUCTURES

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In most oxidation resistant materials, the predominant obstacle to dislocation motion is due to the changes in misfit energy as a dislocation moves, causing them to be brittle. However, at present, there is little understanding of how to design crystal structures to give easy plastic flow. Surprisingly, some hard materials deform readily, but only on a limited number of crystal planes, including ternary carbides and nitrides, such as Ti_3SiC_2, and compounds such as Nb_2Co_7, W_2B_5 and ζ-Ta_4C_{3-x}. Using ternary carbides as an example, it is shown that electronegativity differences within a crystal's unit cell enable dislocation line defects to move much more easily, consistent with observations in other structures. Substantial changes appear possible, suggesting that such an approach might be used as a general way of to tailoring plasticity in crystals.