Development of nanostructured high-strength molybdenum alloys with unprecedented tensile ductility in China

The research team led by Professor Sun Jun of State Key Laboratory for Mechanical Behavior of Materials, Xi'an Jiaotong University, has proposed a new nanostructuring strategy and developed advanced molybdenum alloys with high yield strength over 800 MPa and simultaneously extraordinary tensile ductility as large as ~ 40% at room temperature. These results have been recently published in *Nature Materials* (**2013**, 12: 344—350). The research was supported by the National Natural Science Foundation of China.

The research team proposed that the key to prolong ductility is to split these oxideparticles into nanosized ones and spread them into the grain interior, rather than having them coarsened and concentrated at grain boundaries. They developed a liquid-liquid processing route that involves a molecular-level mixing/doping technique and leads to an optimal microstructure of submicrometer grains with nanometric oxide particles uniformly distributed in the grain interior. The result is a considerable enhancement of the alloys' tensile elongation, fracture toughness and ductile-to-brittle transition temperature, which are properties that best define the applicability of refractory metals for wide structural use. In particular, the combination of yield strength and tensile elongation of the nanostructured Mo alloys significantly exceed all previous reports.

This processing route can be readily adapted to large-scale industrial production of ductile Mo alloys that can be extensively processed and shaped at low temperatures. In addition, the architecture engineered into such multicomponent alloys offers a general pathway for manufacturing dispersion-strengthened materials with both high strength and ductility.

The work has been timely reviewed in"News and Views" of *Nature Materials* (**2013**, 12: 289—291) and in "News and Opinions" of *Nano today* (**2013**, 8: 117—118).

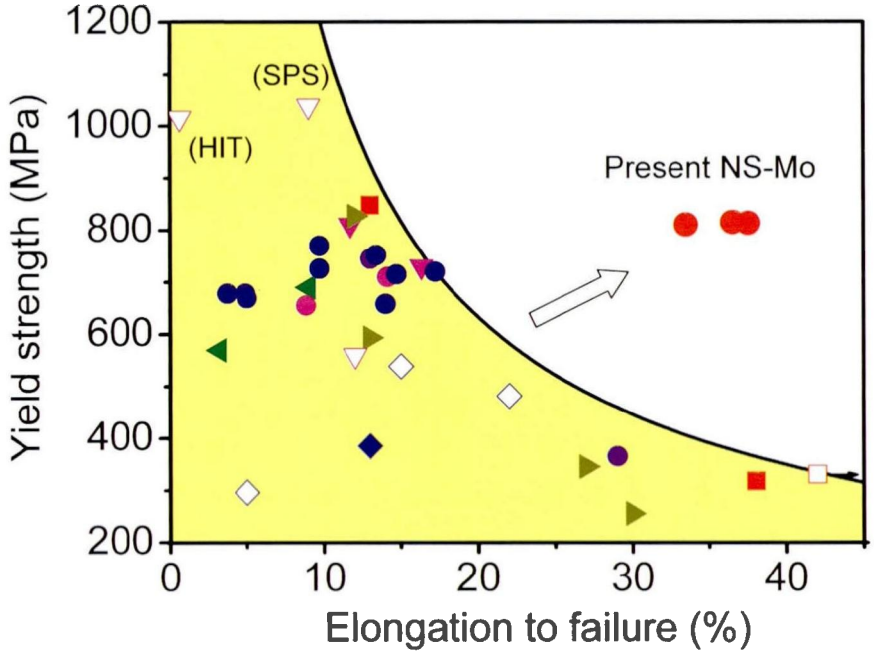

Figure Yield strength versus total tensile elongation of the nanostructured Mo alloys (red filled circles) in comparison with available literature data.