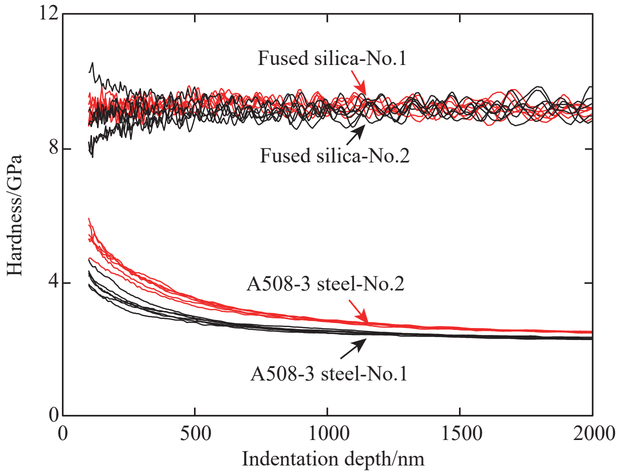

Fig. 1 (color online) Hardness distribution curves with indentation depth for fused silica and A508-3 steel using Berkovich indenters No. 1 and No. 2, respectively.

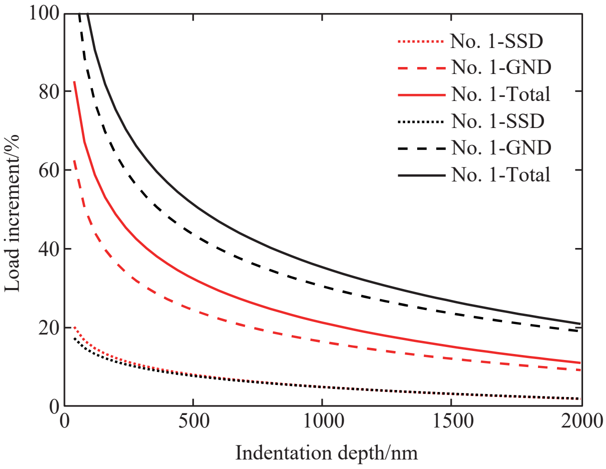

Fig. 2 (color online) Load increments with indentation depth relative to a perfect Berkovich indenter for A508-3 steel using indenters No.1 and No.2.

References

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5 - 36 Impact of Pre-existing Microstructures on Radiation Resistance of Reactor Structural Materials

Han Xuxiao and Zhang Chonghong

In the present work, the irradiation response of two kinds of candidate materials for key components in advanced and fusion reactors, namely oxide-dispersion-strengthen (ODS) steels and vanadium alloys, was investigated. Fe ions supplied by the Heavy ion research facility in Lanzhou (HIRFL) were used to introduce damage in materials. Both pre- and post-irradiation microstructures were mainly investigated by transmission electron microscopy (TEM) while mechanical properties were evaluated by indentation tests.

For ODS steels, after a comparison study with F/M steels and traditional ODS steels, Zr added ODS steels exhibited a better hardening resistance, benefiting from the finer and denser oxides. The inherent mechanism indicates that the decrease in size of dislocation loops in Zr-added ODS steels ascribed from the enhanced sink strength is responsible for the lower hardening. The total sink strength calculated by considering grains, dislocation, and oxides was utilized to correlate pre-exiting microstructures and radiation hardening, providing direct guidance for the designing of advanced ODS steels with improved radiation tolerance. The brief data information is shown in Fig. 1.

For vanadium alloys, cold work deformation with different deformation amounts, and accompanying subsequent annealing was conducted to modify introduced dislocations in materials. Dense and scattering distributions of dislocations were introduced in cold-worked materials while large and tangled network dislocations were set in annealed specimens. The quantitative analysis of dislocation density by XRD shows that a high density with the order of 1×10^{15} m^2 of dislocations existed in materials after severe deformation. In addition, the sink strength calculated mainly considering dislocations shows an inverse relation with radiation hardening for both materials, indicating the effectiveness of dislocations as point defects sink. Fine bubbles with high number density were also observed in all materials after identifying with both TEM and STEM. After comparing with a wealth of data published previously, the introduced bubbles show excellent effects on reducing the radiation hardening of specimens. The brief data information was shown in Fig. 2.

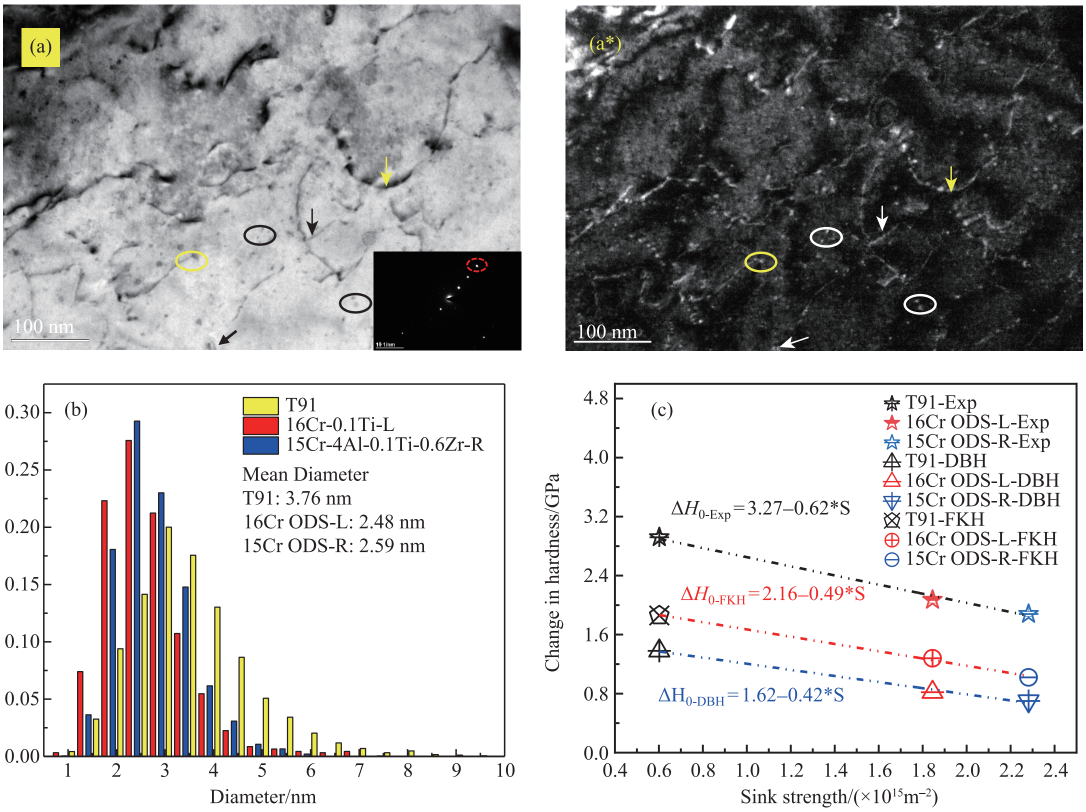

Fig. 1 (color online) (a) Small dislocation loops imaged by TEM with the corresponding dark image (a*), (b) Size distribution of dislocation loops, and (c) Relation between sink strength and radiation hardening.

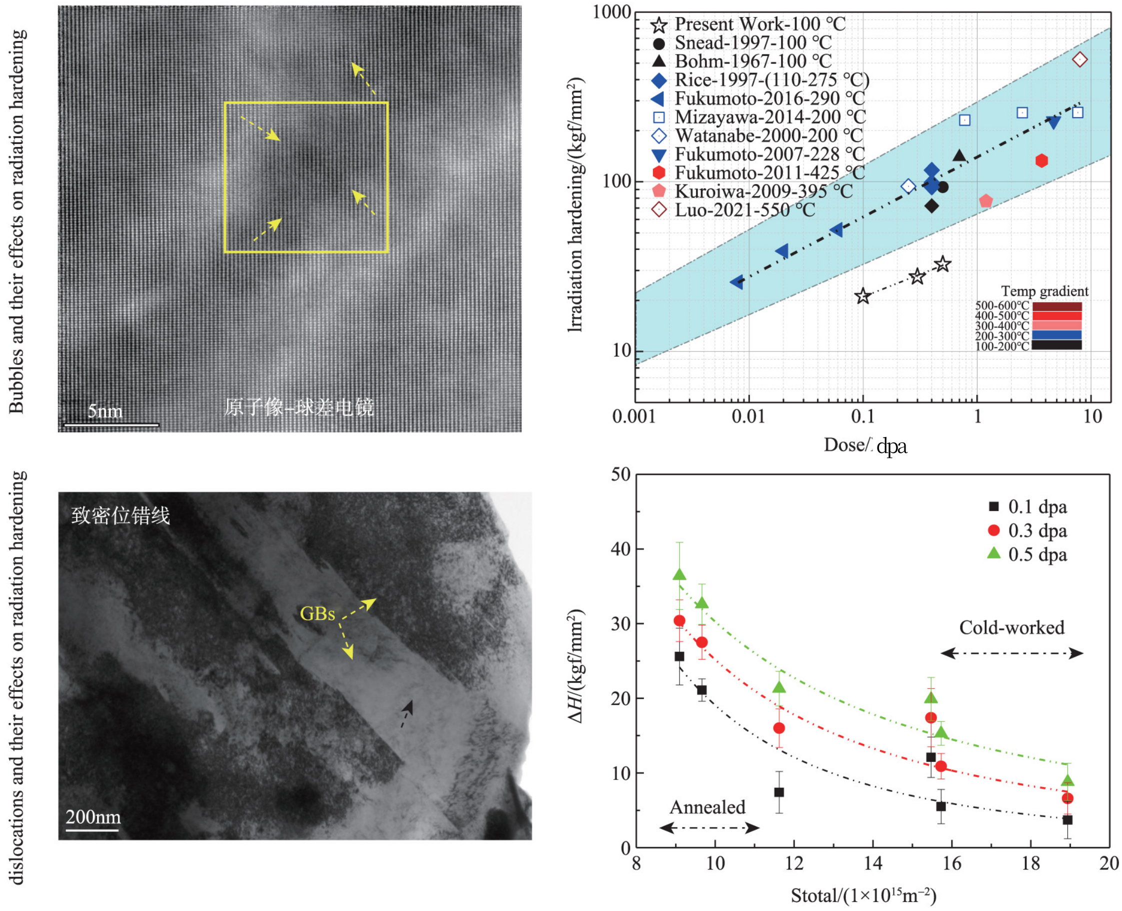

Fig. 2 (color online) (top) as well as (bottom).