High-velocity dust impacts in plasma facing materials: Insights from molecular dynamics simulations

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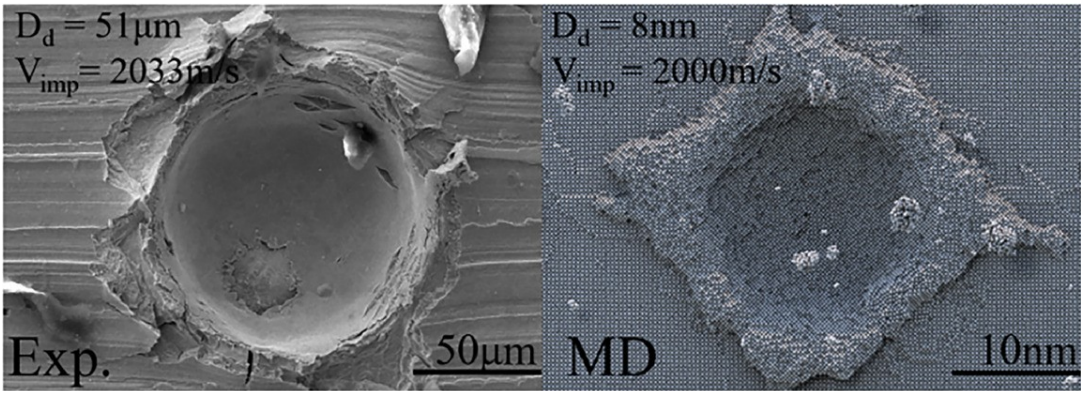
Our research investigated the interaction between high-speed tungsten (W) dust and plasma-facing components (PFCs) in fusion reactors, focusing on W walls [1-3]. Through molecular dynamics (MD) simulations, the study covers a broad spectrum of dust velocities to evaluate their effect on wall materials with various crystal orientations [2]. We found that high-speed impacts cause considerable damage, including sputtering, degradation, and deformation. A damage model derived from experimental and MD data that reveals the patterns and mechanisms of damage caused by dust impacts. The proposed model significantly improves our understanding of dust-wall interactions and underscores the importance of MD simulations as a reliable technique for exploring such phenomena in the challenging conditions of fusion devices. These insights are crucial to predict and mitigate damage to PFCs, helping to develop more resilient and efficient components. Overall, the research offers valuable knowledge on the atomic-level dynamics of dust impacts and represents a notable advancement in the durability and efficiency of materials used in fusion technologies.



References:

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[2] P. Dwivedi et al., J. Nucl. Mater. 594 (2024) 155042.

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