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Nanobodies for Structural Studies: Crystallization Chaperones & Cryo-EM Stabilizers

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Nanobodies, also known as single-domain antibody fragments derived from camelid heavy-chain antibodies, have emerged as valuable tools in structural biology. Due to their small size, high stability, and strong binding affinity, nanobodies serve effectively as crystallization chaperones, aiding in the formation of well-ordered crystals.

Their ability to recognize specific epitopes on target proteins can stabilize transient conformations, facilitating structural determination by X-ray crystallography. Nanobodies can also suppress conformational flexibility, which often hampers crystallization efforts, leading to higher-resolution structures. In cryo-electron microscopy (cryo-EM), nanobodies act as stabilizers by binding selectively to flexible or dynamic regions of macromolecules. This stabilization reduces conformational heterogeneity, resulting in clearer, higher-resolution reconstructions. Moreover, their small size enhances particle orientation diversity, improving data quality.

Nanobodies are also useful as fiducial markers or tags, aiding in particle alignment during image processing. Overall, they have revolutionized structural studies by enabling detailed biological insights into complex, dynamic systems that were previously challenging to analyze, making them indispensable tools in structural biology and drug discovery.

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Track Classification: Structural and Imaging Applications