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Integrating CSM Nanoindentation and Materials Databases for Machine Learning-Based Phase Insights

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A machine learning-assisted approach for phase identification in materials could make use of nanoindentation mapping, particularly continuous stiffness measurement (CSM) data. The richer set of mechanical features accessible through CSM such as hardness, modulus, indentation depth, contact stiffness, energy dissipation, and the evolving H/E ratio combined with freely available materials databases, might allow likely phases in a sample to be suggested. Nanoindentation points could be clustered, providing probabilistic associations with known phases and an interpretable confidence estimate. Optional guidance could be given by specifying the expected number of phase groups or approximate ranges of mechanical properties, while the method could also operate without prior assumptions. As a potential extension, learning-based checks could be included to identify common indentation artifacts such as pile-up or sink-in. This conceptual vision illustrates how the combination of rich mechanical mapping with external material knowledge could support exploratory phase identification in a flexible and informative manner.

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