

# Unavoidable disorder and entropy in multi-component systems

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The need for improved functionalities is driving the search for more complicated multi-component materials. Despite the factorially increasing composition space, ordered compounds with 4 or more species are rare. Here, we unveil the competition between the gain in enthalpy and entropy with increasing number of species by statistical analysis of the AFLOW data repositories. A threshold in the number of species is found where entropy gain exceeds enthalpy gain. Beyond that, enthalpy can be neglected, and disorder - complete or partial - is unavoidable.

“Enthalpy gain”: energetic distance to hull formed from  $N-1$  species components:  $\Delta H [N | \{1, \dots, N-1\}]$

