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Super-Resolution Fluorescence Microscopy Reveals Nanoscale Catalytic Heterogeneity on Single Copper Nanowires

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Abstract

By recording the super-resolved positions of fluorescent product molecules, we reveal locational heterogeneity on the surface of copper nanowire catalysts with single-particle sensitivity and single-turnover resolution. This unveils a gradient activity along the length of nanowire, a result we found to be due to the underlying gradient of unsaturated surface site density resulting from their linear decay in growth rate during synthesis. Within the nanowire, we observed site-specific activity at different regions, where the ratios between the activity at the end regions and side facets are dependent on the length of the nanowire. Examining the single-molecule turnover rate allows for functional interrogations of nanocatalysts at the nanoscale.

Fig. 1: Experimental scheme using total internal reflection fluorescence microscopy and a microfluidic reactor to image the fluorogenic click reaction catalyzed by individual copper nanowires.

Keywords: super-resolution microscopy, click chemistry, copper nanowires, heterogeneous catalysis, nanocatalysts, single-molecule imaging, fluorescence microscopy

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