Steps in gas-surface reactions

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Propositions

1. Curved single crystal surfaces are powerful tools for studying surface chemistry. They are better suited for resolving step density or terrace width dependencies than using multiple flat single crystal surfaces.
   Chapters 3 and 4 of this thesis

2. The quantitative description of hydrogen dissociation at stepped platinum surfaces does not require long-range diffusion of a molecular precursor toward step edges. Kinetic energy is dissipated in the initial collision and the dominant dissociation mechanism is determined by the site of impact.
   Chapter 3 of this thesis

3. Beam experiments on a single-collision basis show that step edges increase overall reactivity in isotopic scrambling of dihydrogen, but that anisotropic diffusion at steps lowers the overall selectivity.
   Chapter 4 of this thesis

4. The 7-fold coordination of edge atoms in A- and B-type steps alone does not capture reactivity dependencies. On Pt(1 1 1), B-type steps are more active in oxygen reduction than A-type steps under steady-state conditions. B-type steps are also more reactive in both oxygen and hydrogen dissociative adsorption.
   Chapter 5 of this thesis

5. Spatial resolution is essential when combining experimental techniques with curved single crystal surfaces. The spatial resolution and its consequential step density convolution should always be reported in publications.

6. Cleaning curved single crystal surfaces requires great care to avoid surface reconstructions and/or surface faceting. All aspects required for reproducible surface preparation should be reported.

7. Molecular beam studies are well-suited for perfectionists – many molecular details influencing reactivity that are usually disregarded can be controlled, e.g. kinetic energy, internal energy, or the molecular orientation during impact.

8. High pressure surface science experiments are essential to determine the surface morphology of active heterogeneous catalysts. Low pressure surface science experiments are essential to understanding the fundamental processes that underlie heterogeneous catalysis.

9. Universities should be pro-active in helping finishing PhD students find their future career path.

10. Despite best efforts by safety departments, hazards and safety risks are sometimes underestimated or ignored. This happens particularly often within universities.