Fundamentals of atomic layer deposition: an introduction ("ALD 101")

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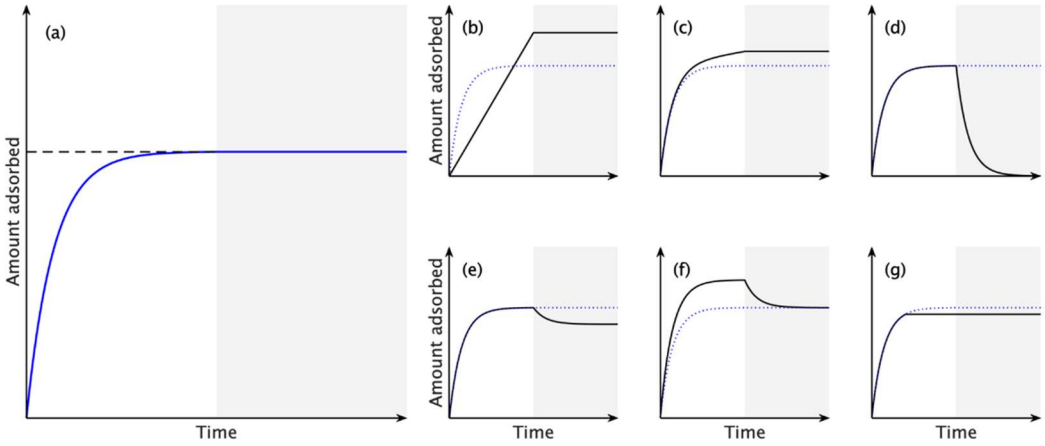

Figure 1: Illustration of various time-dependencies of the amount adsorbed vs. time in gas-solid reactions during reactant exposure (white background) and a following purge/evacuation (grey background): (a) saturating, irreversible reaction (chemisorption); (b) non-saturating continuous reaction; (c) a combination of saturating, irreversible reaction and a continuous reaction component; (d) fully reversible adsorption (either chemisorption or physisorption); (e) partly reversible chemisorption; (f) a combination of saturating, irreversible chemisorption and reversible physisorption; and (g) saturating, irreversible reaction where reactant feed is stopped before saturation occurs. Panel (a) corresponds to ideal atomic layer deposition (ALD). R.L. Puurunen, J.R. van Ommen (own work, 2020), Wikimedia Commons, Creative Commons Attribution 4.0 International license.
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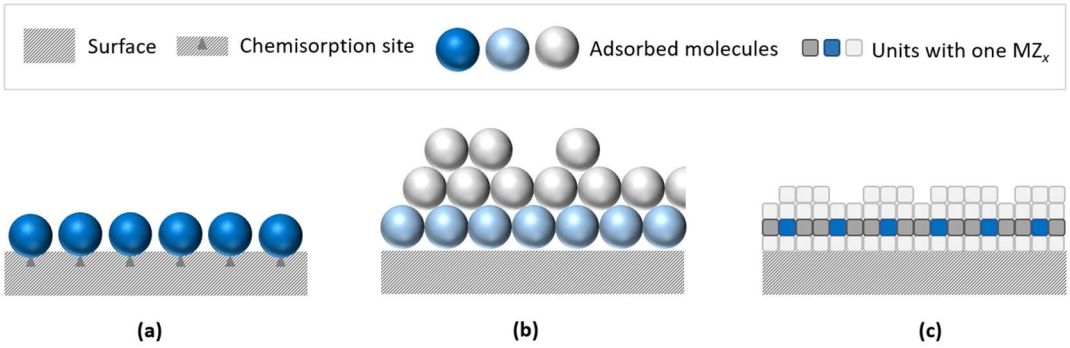

Figure 2: Schematic side-view illustration of three monolayer concepts relevant to atomic layer deposition (ALD): (a) chemisorbed monolayer, which is the basis of ALD growth; (b) physisorbed monolayer, with adsorbed molecules closely packed and with multilayer adsorption on top (can serve as a reference for the maximum obtainable ALD growth per cycle); and (c) a "bulk" monolayer of the ALD-grown MZx material (every third MZx unit highlighted with blue). Riikka Puurunen (own work, 2020), Wikimedia Commons, Creative Commons Attribution 4.0 International license.
https://commons.wikimedia.org/wiki/File:Three_monolayer_concepts_relevant_to_atomic_layer_deposition.png

[1] J.R. van Ommen, A. Goulas, R.L. Puurunen, Kirk-Othmer Encyclopedia on Chemical Technology, submitted.

[2] Atomic Layer Deposition (ALD) in Aalto OpenLearning
https://openlearning.aalto.fi/course/view.php?id=100