

StarQ - Surface treatment at atomic resolution for Quantum Computing

Markus Mohr*¹, Jakob Buchheim¹,

¹German Aerospace Center (DLR), Institute of Quantum Technologies, Wilhelm-Runge-Straße 10, 89081 Ulm, Germany
*markus.mohr@dlr.de

Abstract

Qubits based on NV-centers in diamond are a promising technology platform for Quantum Computing and other Quantum Technologies.

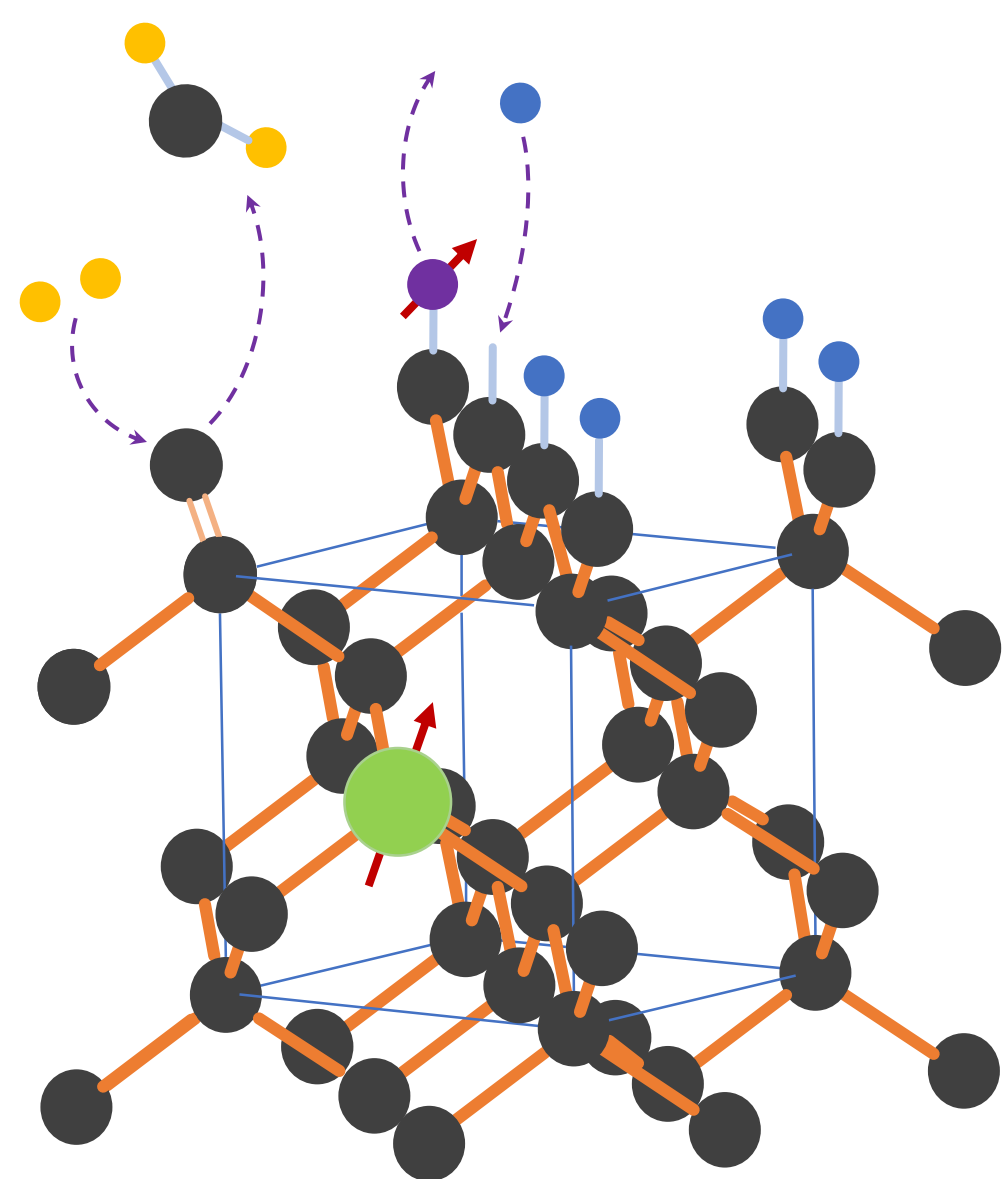
The NV-centers must be electrically charged (NV^-), and decoupled from unintended influences by the surrounding.

Factors that need to be controlled (improving charge state stability, reduction of noise):

- chemical termination of the surface
- adsorbents on the surface
- non-diamond carbon
- spins from surface atoms
- surface roughness

Approach

Surface treatments at an atomic resolution, in order to achieve:



Control over surface on an atomic resolution, by:

- Chemical termination of the surface
- Surface coating at atomic resolution
 - protection against influence of adsorbents
- Surface etching at atomic resolution
 - removal of non-diamond carbon
 - reduce surface roughness
 - structuring to implement functionalities

Industry Cooperations

Cooperation with:

Start-ups developing Quantum Computers on behalf of DLR:



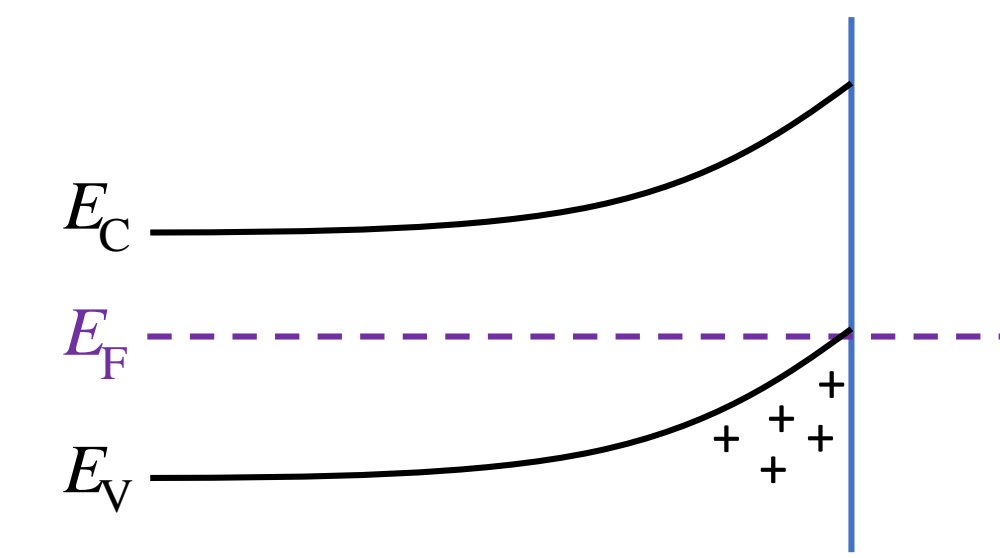
Start-ups for “Spin Enabling Technologies”



Chemical termination of the surface

H-Terminations

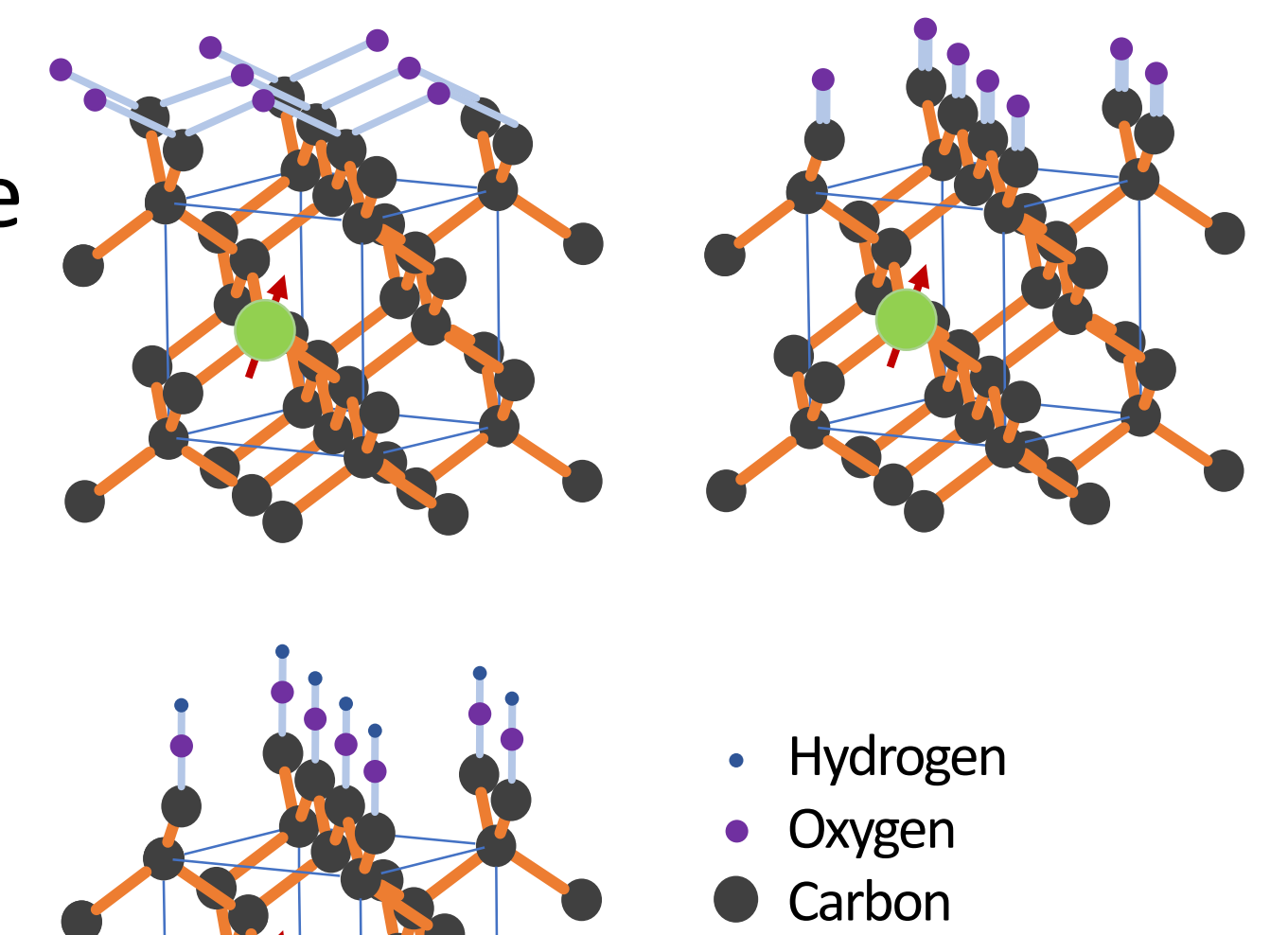
- formed after CVD growth
- discharges the NV-center, forms conductive surface channel



- useful together with metal electrodes to enable/disable Qubit electrostatically

O-Terminations

- known to stabilize charge state
- different chemical structures
- issues with reproducibility & homogeneity, dependent on used oxidation method

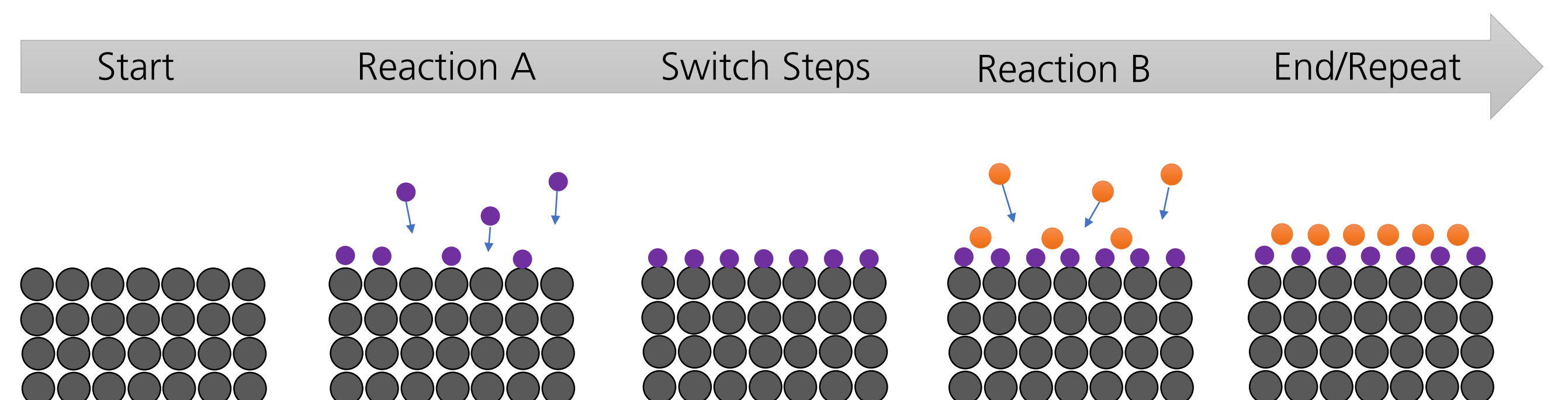


Other Terminations

- Exploration of other, less common terminations (Fluor, Nitrogen, ...)

Surface coating at atomic resolution

Atomic Layer Deposition (ALD) for coatings at atomic resolution

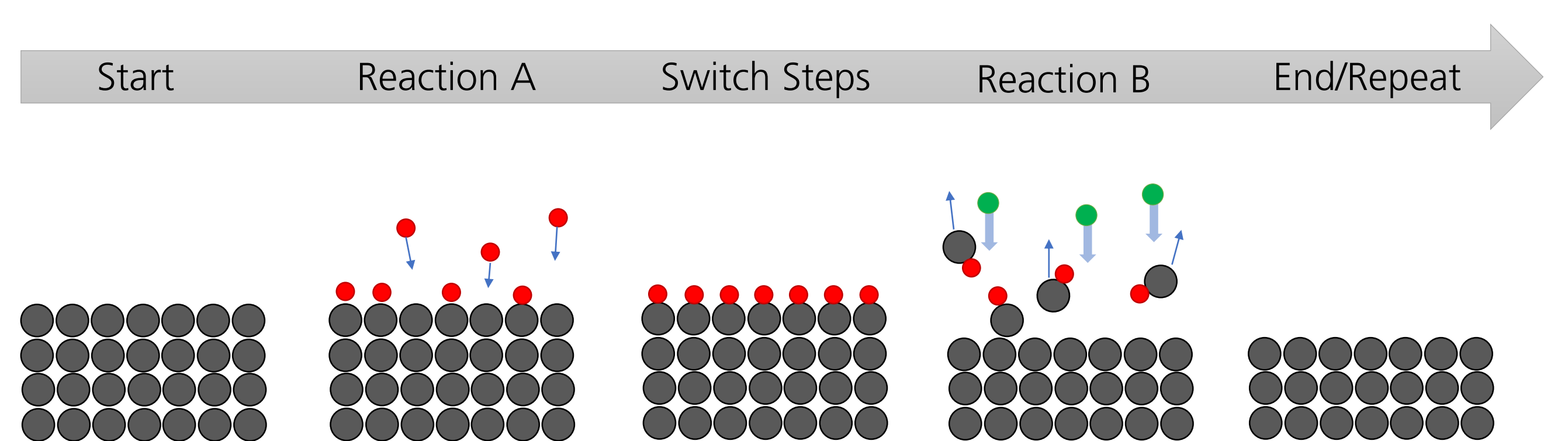


2-step process:

- self-limited adsorption of gas species 1 (chemisorption)
- self-limited adsorption of gas species 2 (chemisorption)

Surface etching at atomic resolution

Atomic Layer Etching (ALE) for etching at atomic resolution



2-step process:

- self-limited adsorption of gas species 1 (chemisorption)
- slight ion bombardment with gas species 2 (etching)

Gefördert durch:



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