## Supplementary Information

# Tailer the antibacterial efficiency of copper alloys by oxidation: when to and when not to

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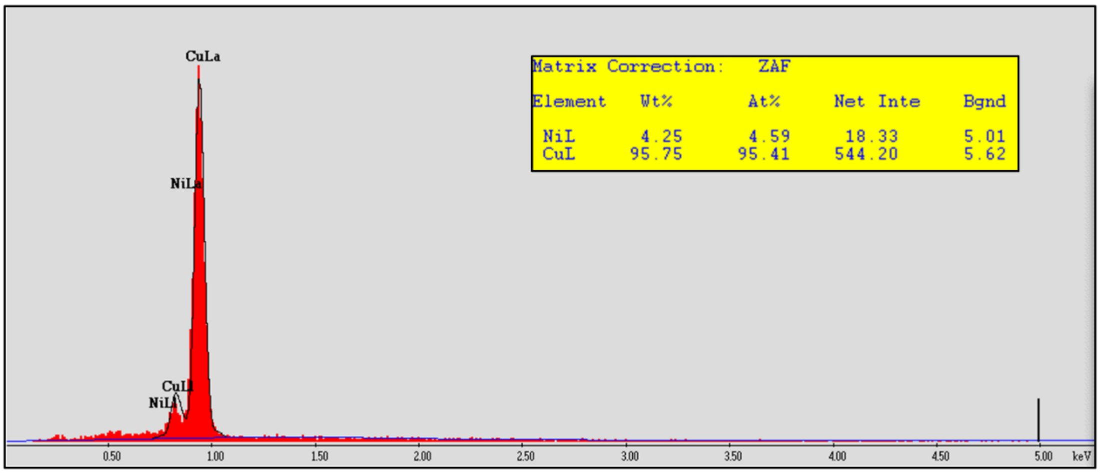
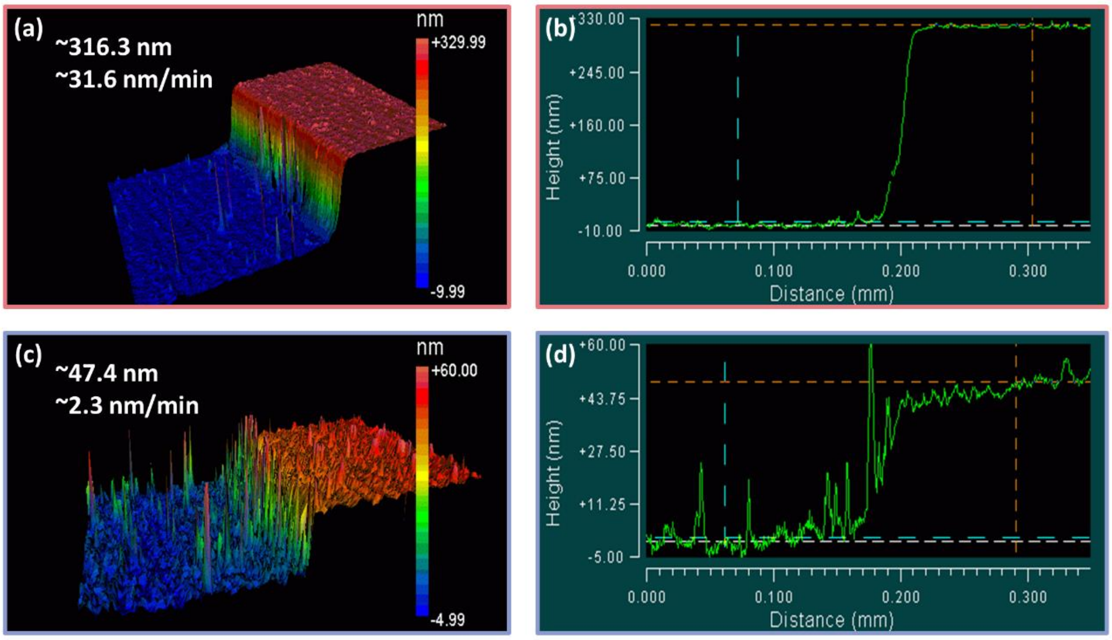


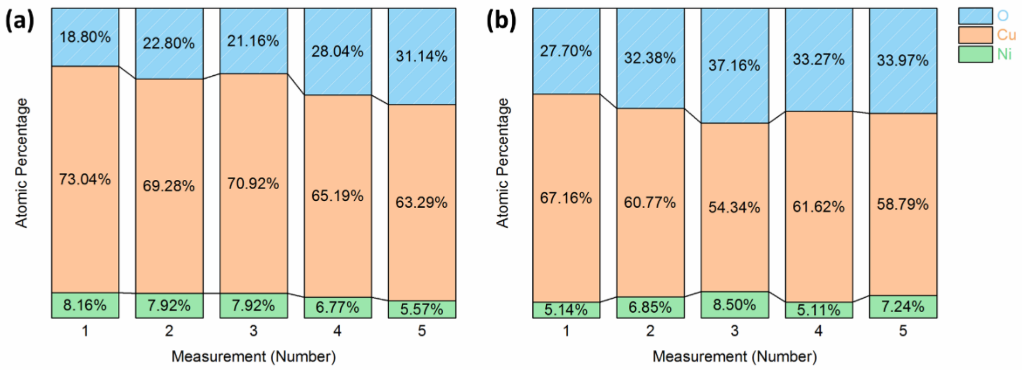

**Supplementary Figure 1** | Typical EDS spectrum collected from pure copper, where quantitative analysis with ZAF correction was done with Ni and Cu.

**Brief interpretation**: This illustrates the impact of overlap between CuL and NiL in quantification: there will be a minimum of 4% to 5% of Ni presenting in the result if Ni is considered and manually selected, even though there is actually no Ni in the couple at all. An alternative to better quantify Cu and Ni would be considering their $K_\alpha$ peaks at 8.04 and 7.48 keV, respectively. This, however, can only be done with a higher acceleration voltage of the electron beam, which means thicker thin films are also required to ensure the electrons cannot reach the substrate and do not excite the irrelevant elements.



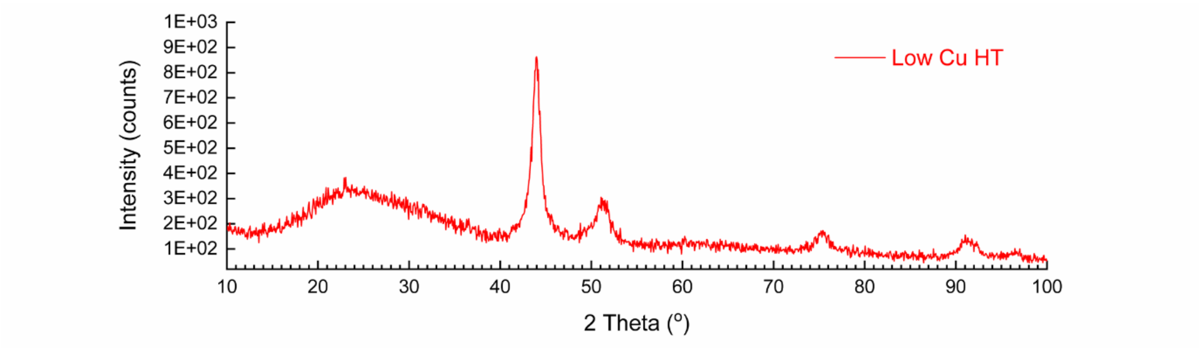

**Supplementary Figure 2** | Profile and thickness measurement by white light interferometer (NewView 7300, Zygo, 20X) of as-deposited coupons: high copper content thin films **(a, b)** and low copper content thin films **(c,d)**.

**Brief interpretation**: Higher sputtering current of Cu was applied, resulting in an 8 times thicker thin films within half of the sputtering time, however, the values shown in **(b)** and **(d)** do not necessarily represent an average thickness as the lateral inhomogeneity cannot be totally avoided.



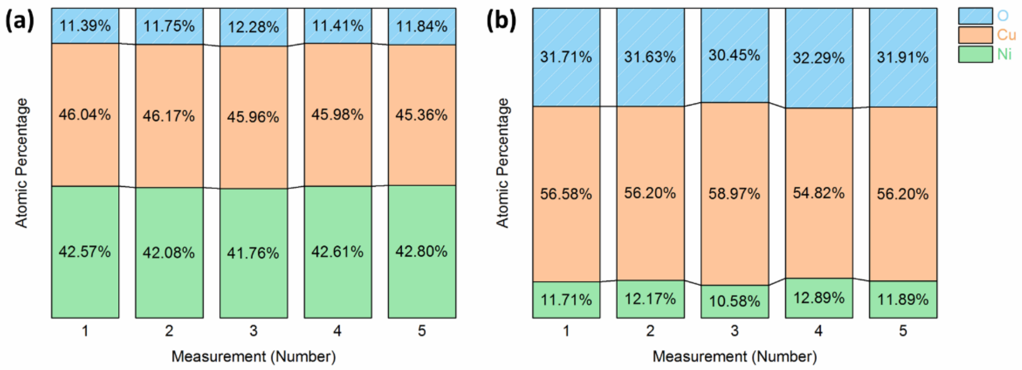

**Supplementary Figure 3 |** Quantitative results (after ZAF correction where Ni, Cu and O were selected) of two different regions found on the 200° C heat-treated high copper content coupon: outside the strong oxidation regions **(a)** and inside these regions **(b)**.

**Brief interpretation**: Five individual measurements on different locations were performed on each type of region. Average values of these data are calculated and presented in the main text Figure 2.



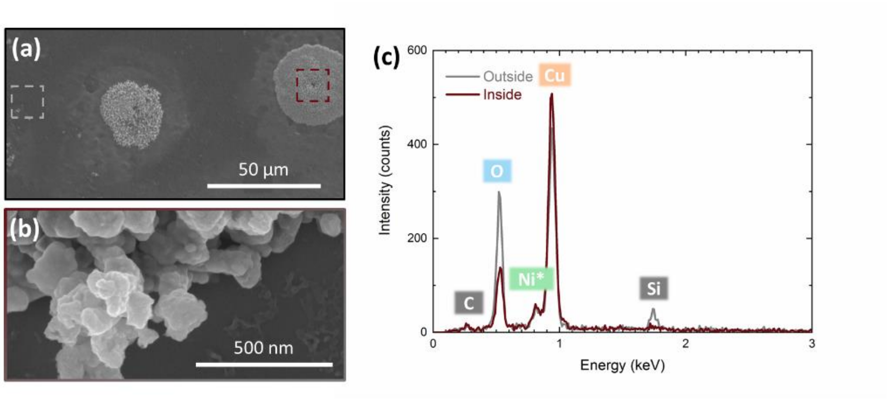

**Supplementary Figure 4** | High resolution GIXRD results of low copper content thin films heat treated at 200° C for 72 h.

**Brief interpretation**: Prolonged heat treatment period does not introduce obvious oxide formation on low copper content thin films.




**Supplementary Figure 5 |** Quantitative results (after ZAF correction where Ni, Cu and O were selected) of two different regions found on the 250° C heat-treated low copper content coupon: outside the strong oxidation regions **(a)** and inside these regions **(b)**.

**Brief interpretation**: Five individual measurements on different locations were performed on each type of region. Average values of these data are calculated and presented in the main text Figure 4.




**Supplementary Figure 6 |** Typical SEM image **(a)** and high resolution SEM image **(b)** from the edge of two different regions found on the 250° C heat-treated high copper content coupon. EDS spectra **(c)** were collected from the regions that marked by squares in (a). The label of Ni is marked with star in order to remind the readers of the likely overlap between NiL and CuL.

**Brief interpretation**: Quantification has not been performed as one could already find the signal originated from Si. This could represent two scenarios: Si atom diffused from the glass substrate and entered the thin film, and/or X-ray emitted by the glass substrate reached the surface and therefore was connected. If the latter is the actual situation, then ZAF correction will not work properly as it assumes a mixture of homogenous distributed elements rather than a layer structure.