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Surface Characterization Studies of Gold-Plated Niobium

Abstract #SUSPB024

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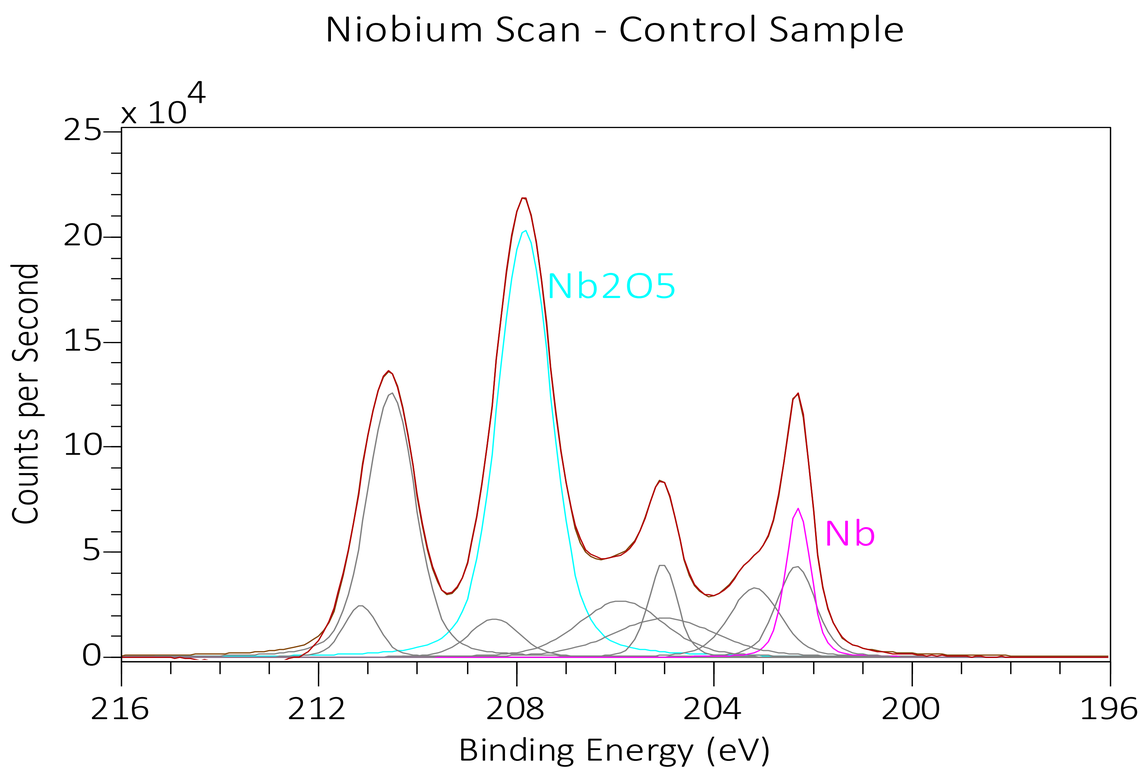
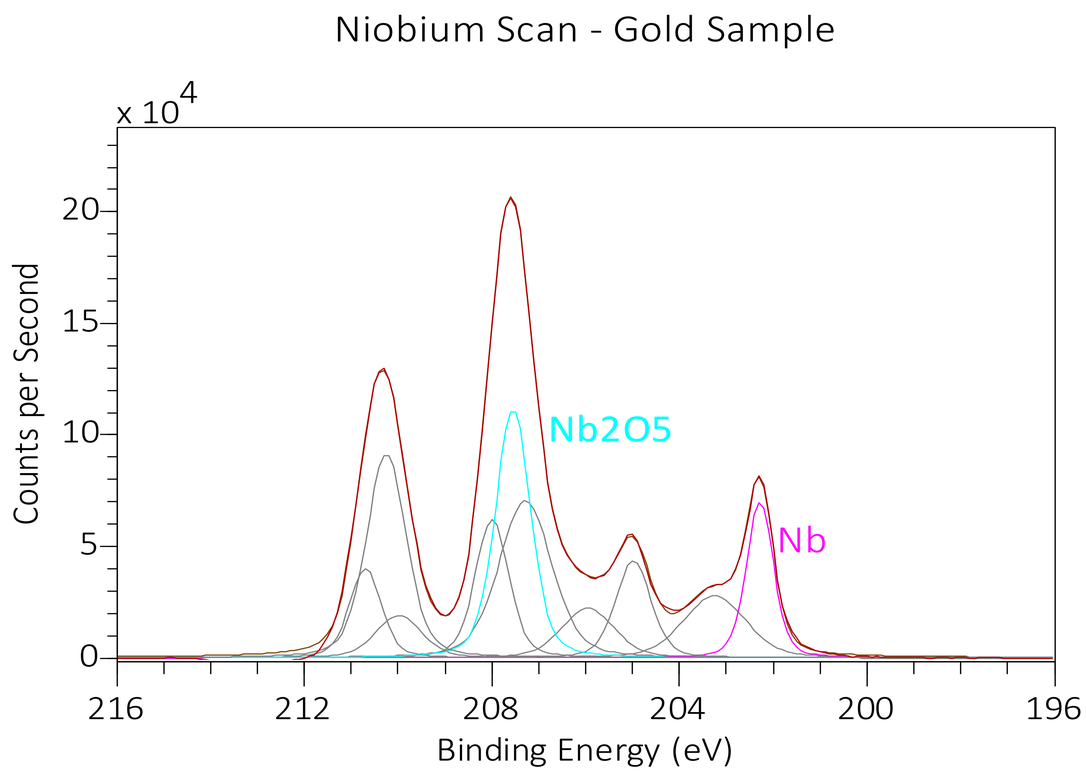
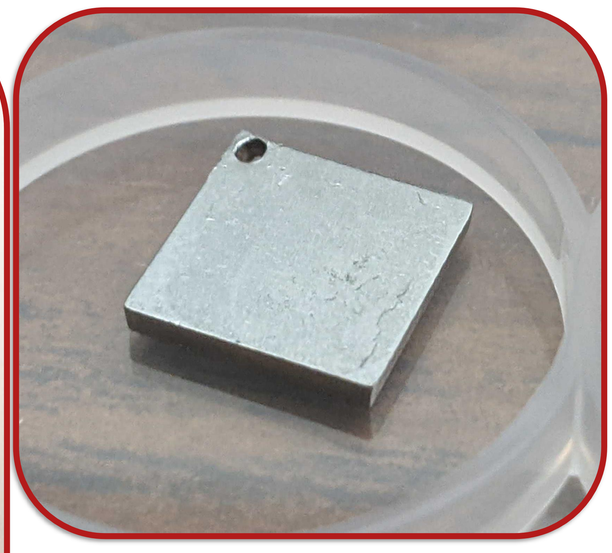
XPS shows presence of gold impacts niobium oxide; gold deposition shows promise toward oxide passivation.





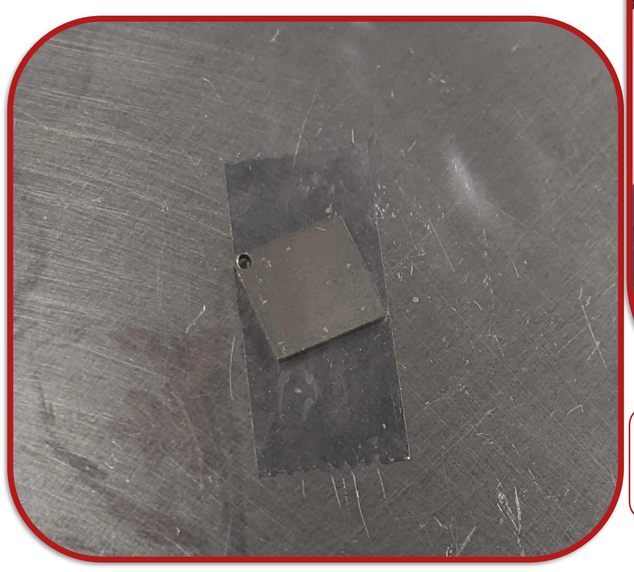
XPS analysis of niobium of two samples, one control (left) and one with 1nm of gold deposited (right).

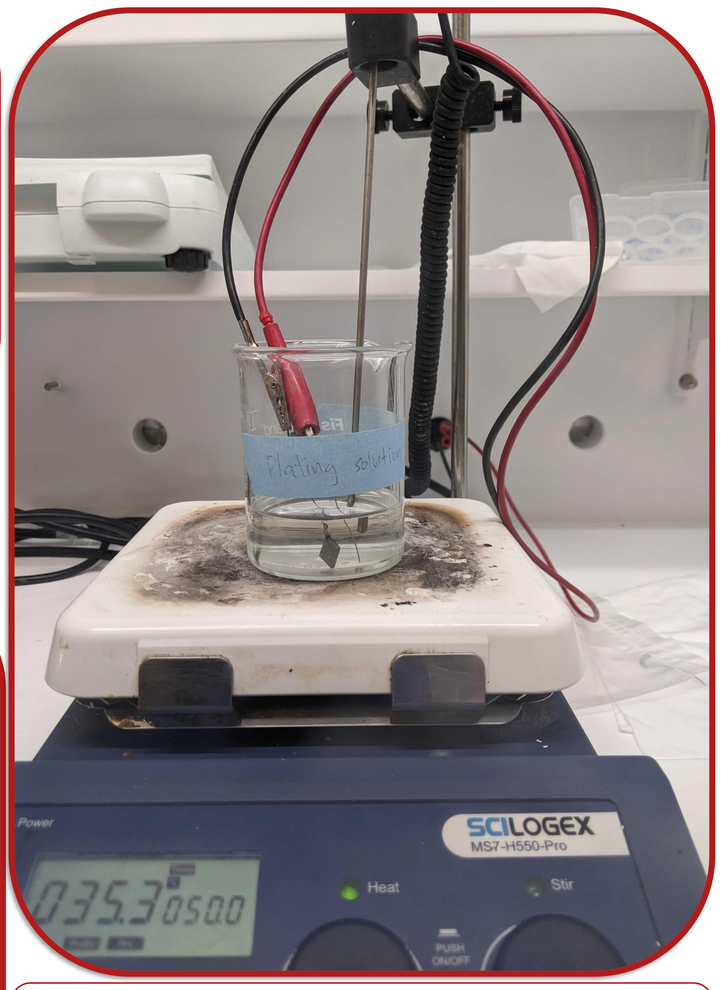
Above: CVC SC4500 evaporation deposition chamber, used to deposit thin gold layers.



Left: 1cm by 1cm niobium sample, in holder used for transport. Hole at top left was used for hanging sample during processes.

Right: 1cm by 1cm niobium sample, immediately post-gold deposition. Sample is attached to an aluminum puck with tape.





Above: Electroplating setup, in development for gold deposition.

Goals and Future Work

- This study aims to analyze the impact of gold deposition on the native oxide present on bare niobium.
- This is a continuation of previous work analyzing potential improvements to RF performance obtained by depositing gold on niobium.
- XPS offers a direct way of characterizing the presence of various elements on a surface.
- Gold deposition shows promise for impacting the niobium oxide.
- Evaporation deposition can be used to deposit gold on samples, but does not scale to a full cavity.
- Development of an electroplating setup (which would allow for full-cavity plating) is underway.

Full Abstract

The native niobium oxide layer present on niobium has been studied in an attempt to understand the effect of the oxide on cavity performance. Extremely thin layers of gold on the surface of niobium have the potential to suppress surface oxidation and improve cavity performance. However, depositing uniform layers of gold at the desired thickness (sub-nm) is difficult, and different deposition methods may have different effects on the gold surface, on the niobium surface, and on the interface between the two. In particular, the question of whether gold deposition actually passivates the niobium oxide is extremely relevant for assessing the potential of gold deposition to improve RF performance. This work builds on previous research studying the RF performance of gold/niobium bilayers with different gold layer thicknesses. We here consider alternative methods to characterize the composition and chemical properties of gold/niobium bilayers to supplement the previous RF study.

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