

# Hybrid Superconducting Nanowire Single Photon Detectors

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## 1. Abstract

In order to reduce some limitations of Superconducting Nanowire Single Photon Detectors (SNSPDs), we aim to develop hybrid systems combining Nb and graphene. In this figure we can see some microscopy images of 1 mm-long and 300 nm wide meanders obtained with scanning electron microscopy (SEM) and atomic force microscopy (AFM).

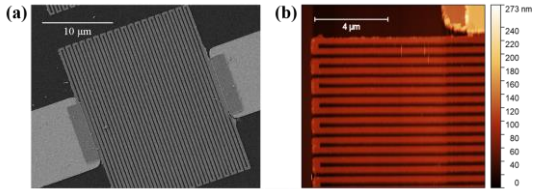


Figure 1. Nb meander images. (a) SEM; (b) AFM

## 2. Fabrication

The Nb meanders of nanowires have been fabricated by electron beam lithography (EBL) with PMMA resist on SiO<sub>2</sub>/Si substrates and gold electrodes followed by metal evaporation with a thickness of 50 nm.

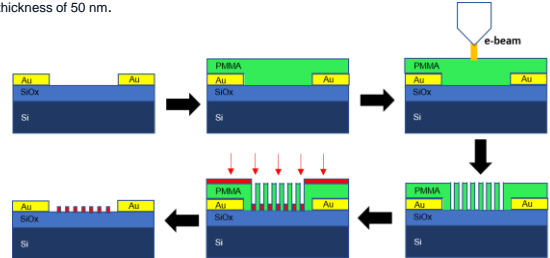


Figure 2. Nanofabrication process by EBL and metal evaporation.

## 3. Experimental Data

The superconducting properties of the Nb meanders such as  $I_c$  or  $T_c$  have been determined as well as their photoresponse to white and 488 nm laser light under several powers of illumination as we can see in the following figure. We found that the maximum photoresponse varied along the illumination power spatially. At high power illumination the maximum was located in the centre of the meander whereas at low power illumination it was located at the edges. We are currently studying the dynamic response to pulsed light (488 nm) of some Nb microwires with graphene.

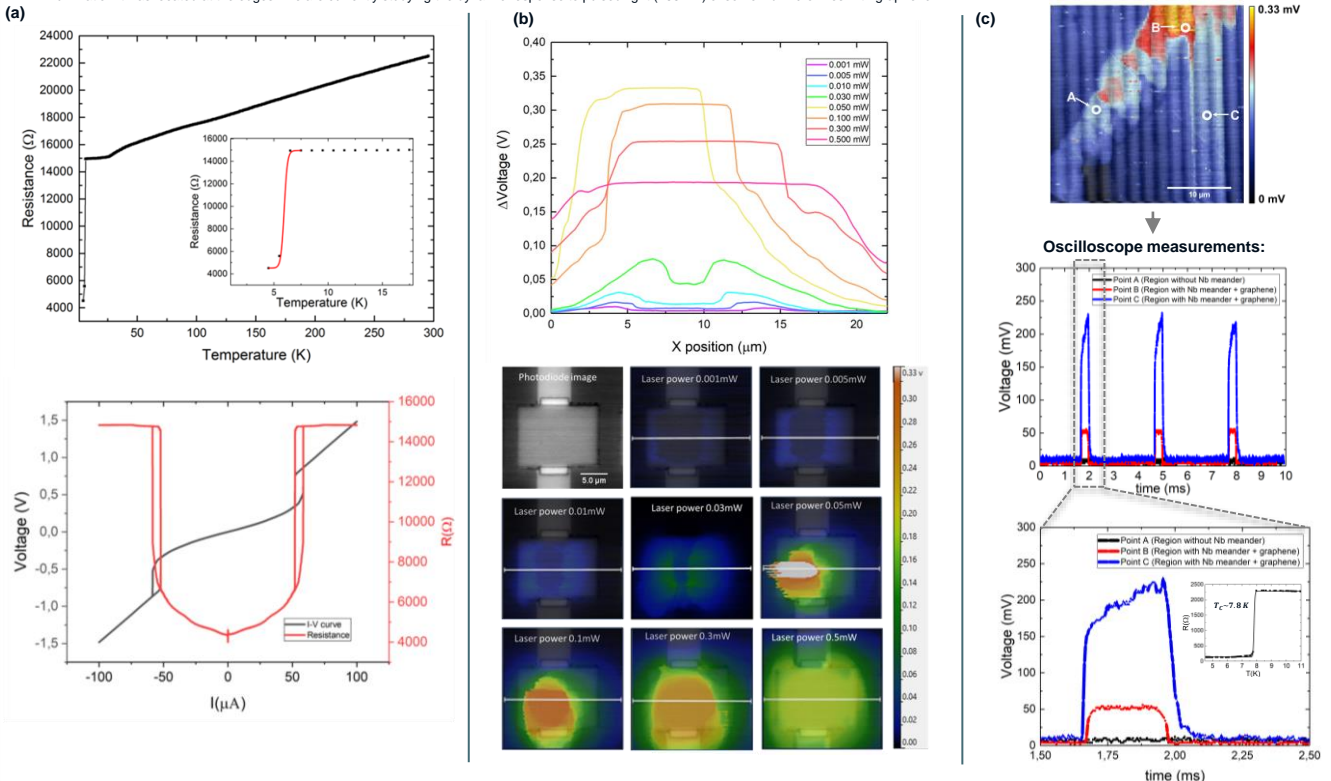


Figure 3. (a)  $R(T)$  curve of a Nb meander shows the superconducting transition and I-V curve obtained at  $T=4.48$  K (b) Voltage difference vs position detected in the profile (white line) of the meander showed below. Photoresponse maps under illumination of 488 nm laser light and photodiode image of a Nb meander at different laser powers. (c) Photoresponse map of hybrid system composed of 2  $\mu$ m wide Nb meander with graphene and the voltage pulses measured with the oscilloscope when illuminating the sample at 333 Hz in several regions of the sample. The inset shows the superconducting transition with  $T_c=7.8$  K.

## 4. Conclusions

- Electrical measurements have shown  $T_c \approx 5.8$  K and  $I_c(T=4.48$  K)  $\approx 58$   $\mu$ A.
- The meanders show photoresponse to white light and 488 nm laser light.

**Future Work:** Graphene will be grown by CVD and transferred to the top part of the meanders.

## 5. References

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