Highlights

Light-matter interaction and non-equilibrium dynamics in advanced materials and devices - 2019

Superconductor to resistive state switching by multiple fluctuation events in NbTiN nanostrips

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We report on measurements of the switching current distributions on two-dimensional superconducting NbTiN strips that are 5 nm thick and 80 nm wide. We observe that the width of the switching current distributions has a non-monotonous temperature dependence, where it is constant at the lowest temperatures up to about 1.5 K, after which it increases with temperature up to 2.2 K. Above 2.5 K any increase in temperature decreases the distribution width which at 4.0 K is smaller than half of the width observed at 0.3 K. By using a careful analysis of the higher order moments of the switching distribution, we show that this temperature dependence is caused by switching due to multiple fluctuations. We also find that the onset of switching by multiple events causes the current dependence of the switching rate to develop a characteristic deviation from a pure exponential increase, that becomes more pronounced at higher temperatures, due to the inclusion of higher order terms.

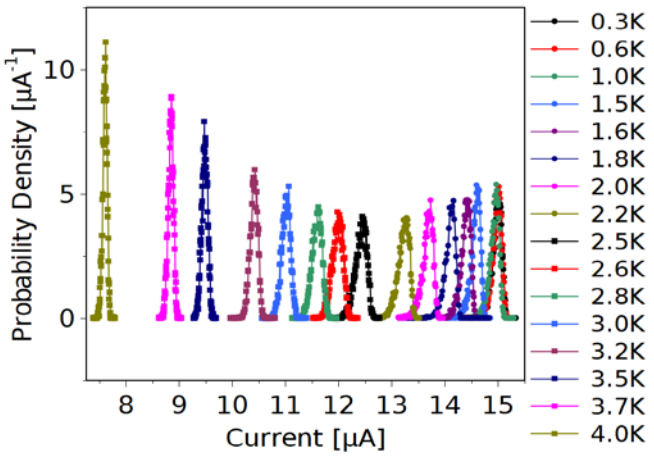

Fig. 1: Measured switching-current distributions for temperatures between 0.3 K (right-most) and 4 K (left-most) that shows the counterintuitive narrowing with increased temperature above 2.5 K.

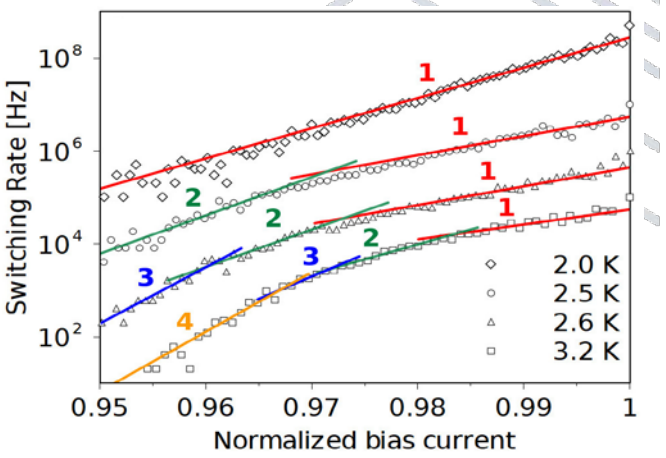

Fig. 2: Switching rates for four different temperatures. The solid lines are fits to the data using the indicated higher order multiple phase slip events included. For clarity we have multiplied both the data and fits by a factor of 10 (2.6 K), 100 (2.5 K) and 5000 (2.0 K) respectively.