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Uniform non-stoichiometric titanium nitride thin films for improved kinetic inductance detector array

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The aluminum Kinetic Inductance Detectors (KIDs) for the NIKA (Néel IRAM KIDs Array) instrument are now well optimized and at their limit. To further increase the sensitivity, a higher value of the kinetic inductance is needed. It can be achieved by reducing the thickness of the films. We are already working with less than 20-nm thick aluminum films and thinner films are difficult to produce in terms of deposition process. A possible solution is to use another material such as sub-stoichiometric titanium nitride Ti1-xNx which is known to have a high value of kinetic inductance. This property makes TiN suitable for kinetic inductance detectors. Moreover, the superconducting transition temperature, TC, of TiN can be tuned between 0.5 K and 4.5 K in order to use it for mm-wave detection. For arrays, large scale uniformity is important. This is a challenge for TiN because of very strong variation of TC with the nitrogen content. We investigate the crystallographic structures and the composition of the films depending on the nitrogen content. We show that the variation of TC is due to the nitrogen content and not to a variation of the thickness of our films. We present an ellipsometry measurement that is correlated to the value of the critical temperature. This rapid characterization is used to map substrates and to visualize the nitrogen content in the films. Thank to this technique, we determined that our films were strongly non-homogenous. We describe upgrades of our sputter deposition chamber that allow uniform TiN films to be fabricated. We have improved the uniformity of large TiN arrays and we present measurements of these arrays with 132 pixels.