



⊗ **Nb_xTi_{1-x}N Superconducting-Nanowire Single-Photon Detectors**

Potential applications include optical communications and quantum cryptography.

NASA's Jet Propulsion Laboratory, Pasadena, California

Superconducting-nanowire single-photon detectors (SNSPDs) in which Nb_xTi_{1-x}N (where $x < 1$) films serve as the superconducting materials have shown promise as superior alternatives to previously developed SNSPDs in which NbN films serve as the superconducting materials. SNSPDs have potential utility in optical communications and quantum cryptography.

NbN-based SNSPDs have exhibited, variously, high detection efficiency, low signal jitter, large dynamic range, and low dark counts, but it has been difficult to fabricate detectors that exhibit all of these desirable properties simultaneously. It has been even more difficult to produce NbN-based SNSPDs in high yield, especially in

cases in which the detectors occupy areas larger than 5 by 5 μm .

Nb_xTi_{1-x}N is a solid solution of NbN and TiN, and has many properties similar to those of NbN. It has been found to be generally easier to stabilize Nb_xTi_{1-x}N in the high-superconducting-transition-temperature phase than it is to so stabilize NbN. In addition, the resistivity and penetration depth of polycrystalline films of Nb_xTi_{1-x}N have been found to be much smaller than those of films of NbN. These differences have been hypothesized to be attributable to better coupling at grain boundaries within Nb_xTi_{1-x}N films.

Four batches of prototype Nb_xTi_{1-x}N SNSPDs fabricated thus far have shown a

yield >60 percent — much higher than the yields of NbN SNSPDs. In two of the batches, the SNSPDs were fabricated in high-resonance-quality-factor (high-*Q*) cavities by use of commercial dielectric mirrors. The SNSPDs in the high-*Q* cavities simultaneously exhibited high detection efficiencies, low dark counts, small jitter, and high yield for a resonance wavelength of 1,064 nm. In the most recent two lots fabricated, the yield was high even for large-area (10 by 10 μm) SNSPDs.

This work was done by Jeffrey A. Stern, William H. Farr, Henry G. Leduc, and Bruce Bumble of Caltech for NASA's Jet Propulsion Laboratory. For more information, contact iaoffice@jpl.nasa.gov. NPO-45603

⊗ **Neon as a Buffer Gas for a Mercury-Ion Clock**

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One aspect of the topic of "Compact, Highly Stable Ion Clock" (NPO-43075), *NASA Tech Briefs*, Vol. 32, No. 5 (May 2008), page 63, is examined in more detail. To recapitulate: A developmental miniature mercury-ion clock has stability comparable to that of a hydrogen-maser clock. The ion-handling components are housed in a sealed vacuum tube, wherein a getter pump is used to maintain the partial vacuum, and the evacuated tube is backfilled

with mercury vapor in a buffer gas.

The development has included a study of gas-induced shifts of the clock frequency and of alternatives to the traditional use of helium as the buffer gas. The frequency-shifting effects of three inert gases (helium, neon, and argon) and three getterable gases (hydrogen, nitrogen, and methane) were measured. Neon was determined to be the best choice for the buffer gas: The pressure-induced frequency pulling by

neon was found to be only about two-fifths of that of helium. Furthermore, because neon diffuses through solids much more slowly than does helium, the operational lifetime of a tube back-filled with neon could be considerably longer than that of a tube backfilled with helium.

This work was done by John Prestage and Sang Chung of Caltech for NASA's Jet Propulsion Laboratory. For more information, contact iaoffice@jpl.nasa.gov. NPO-42919

⊗ **Miniature Incandescent Lamps as Fiber-Optic Light Sources**

These lamps can be used without coupling optics.

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Miniature incandescent lamps of a special type have been invented to satisfy a need for compact, rapid-response, rugged, broadband, power-efficient, fiber-optic-coupled light sources for diverse purposes that could include cali-

brating spectrometers, interrogating optical sensors, spot illumination, and spot heating. A lamp of this type (see figure) includes a re-entrant planar spiral filament mounted within a ceramic package heretofore normally used to

house an integrated-circuit chip. The package is closed with a window heretofore normally used in ultraviolet illumination to erase volatile electronic memories. The size and shape of the filament and the proximity of the fila-