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Optically Activated Two-Level Systems in a Thin-Film Superconducting Microwave Resonator[1] R.P. BUDOYO, JQI and CNAM, Dept. of Physics, University of Maryland, College Park, J.B. HERTZBERG, JQI, Dept. of Physics, University of Maryland, College Park, C.J. BALLARD, JQI and CNAM, Dept. of Physics, University of Maryland, College Park, K.D. VOIGT, JQI, Dept. of Physics, University of Maryland, College Park, J.R. ANDERSON, C.J. LOBB, F.C. WELLSTOOD, JQI and CNAM, Dept. of Physics, University of Maryland, College Park — We have fabricated an isolated thin-film superconducting Al lumped-element resonator (resonant frequency 6.72 GHz) on a sapphire substrate and mounted it inside an Al 3d cavity (TE101 mode frequency 7.50 GHz). The thin-film resonator is very weakly coupled to the microwave drive line with $Q_e \approx 5 \times 10^9$. We illuminated the resonator with 780 nm light from an optical fiber and measured the internal loss in the resonator and its dependence on applied optical and rf powers at temperatures as low as 20 mK. With no applied optical power, the resonator reaches an internal quality factor $Q_i \approx 2 \times 10^6$ at high rf photon numbers. Our measurements show that the applied optical power causes an increase in loss due to an apparent increased contribution from two-level systems as well as the expected increase from quasiparticles. We discuss our results and possible mechanisms for the optical activation of two-level systems.

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