geometrical considerations nuclear reactions will take place dominantly with nuclei in preferred states of alignment.

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Saturation of Nuclear Electric Quadrupole Energy Levels by Ultrasonic Excitation*

W. G. Proctor and W. H. Tanttila
Department of Physics, University of Washington, Seattle, Washington
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We have observed the decrease in the population difference between the degenerate $m=\pm\frac{1}{2}$ and the $m=\pm\frac{3}{2}$ quadrupole energy levels of Cl^{35} in $NaClO_3$ following a long pulse of ultrasonic excitation at the transition frequency. The experiment was performed at the temperature of liquid nitrogen, for which the transition frequency is 30.63 Mc/sec and the thermal relaxation time 0.94 sec.

The population difference was measured by the amplitude of the transient nuclear induction signal following a short (50 μsec) pulse of radio-frequency magnetic flux at the transition frequency.[1] In our experiment, the signals were induced in a second coil, a receiver coil, perpendicular to the exciting or transmitter coil, as suggested by Dean.[2] The sodium chlorate crystal, about 1 cm^3 in volume, located between the above coils, received ultrasonic energy in the (1,0,0) direction across a polished face in contact with the polished face of a long, narrow halite crystal. The latter was joined similarly to a second halite crystal, joined in turn to an X-cut quartz crystal, used as an ultrasonic transducer. Rubber-vaseline vacuum grease was used as an interface medium. The halite crystals, about 1 cm^2 in cross section, were each about 4 cm long, separating the quartz transducer from the $NaClO_3$ sample by about 8 cm. The transducer was excited by a second transmitter of variable frequency; current reached the transducer through a coaxial cable, of which the outer, grounded conductor was flared out at the end to enclose the quartz transducer completely and make contact with the silver coating of its outside face, thus preventing magnetic fields from originating from the transducer to a great extent.

The ultrasonic pulse was 0.3 second in duration; the rf power supplied to the transducer was about 5 watts. After a delay of about 0.03 second, the population difference was examined. The cycle was repeated at 1-second intervals. Depending upon a number of variables, it was observed that the amplitude of the transient was diminished to 20 percent or less of its equilibrium amplitude only when the transducer was excited at the transition frequency. To separate the ultrasonically induced quadrupole transitions from a spurious effect which would be obtained by dipole transitions caused by magnetic flux leaking into the sample region, the resonant transmitter and receiver coils were short-circuited by relays during the ultrasonic excitation period. Further, after a small gap ($\sim\frac{1}{2}$ mm) was introduced between the sample crystal and its neighboring halite crystal, interrupting the path of ultrasonic energy while providing a geometry and transducer loading for which one would expect almost identical leakage fluxes, no attenuation was discernable. A further possible spurious effect, due to the generation of a temperature gradient in the sample crystal, is not likely since the transducer heating should not be frequency-dependent; the transducer, driven at the third harmonic, tuned broadly when loaded.

Quantitative measurements are now under way. The experiment was performed in order to be able to measure the direct and Raman process contributions to the thermal relaxation time.[3]

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Experimental Evidence for Thermal Spikes in Radiation Damage*

W. Primak
Chemistry Division, Argonne National Laboratory, Lemont, Illinois
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Theoretical work[1–3] and experimental measurements of stopping power indicate that toward the ends of their ranges in solids, energetic atoms lose $\sim 10^4$ ev to the lattice at a rate of about 10^9–10^{10} ev/cm. Brooks[4] discussed the resultant temperature fluctuations (termed thermal spikes). He showed that the thermal spikes in the electronic system are small, behave nearly independently, and cannot produce marked structural effects. For the lattice, the temperature distribution would be between cylindrical and spherical

$$T\sim 3(10^{-21})(q/c)(x^2t)^{-1}\exp(-r^2/4x^2t) \quad \text{or} \quad 10^{-21}(Q/c)(x^2t)^{-\frac{3}{2}}\exp(-r^2/4x^2t),$$