AMMONIA AT 10^6 V/CM IN AN 8K ARGON MATRIX: POLARIZATION, ORIENTATION, AND PENDULARIZATION

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The ν_2 band of NH_3 and ND_3 in solid Ar at 8K inside an ice-film nanocapacitor is observed by reflection-absorption infrared spectroscopy (RAIRS). Ammonia is an almost-free rotor in the Ar matrix. As the electric field is increased up to 1x10^6 V/cm, the spectrum undergoes a sequence of (reversible) changes driven by two kinds of Stark effect: mixing of inversion doublet components (for $K_c \geq 1$) and c-dipole type ΔK=0, ΔJ=$\pm$1 J-mixing. Mixing of inversion doublets results in quenching of the inversion dynamics and J-mixing leads toward pendularization. H vs. D nuclear permutation symmetry effects are clearly visible in the spectrum. At 10^6 V/cm and 8 K, the Stark interaction energy, μE = 25 cm^{-1}, is larger than kBT = 5.6 cm^{-1} and intermediate between the inversion splittings in the NH_3 v=0 and v_2=1 levels, 0.79 and 36.5 cm^{-1}. This frequency domain spectrum in a scanned DC electric field encodes a more complete dynamical picture than experiments in which an extremely high electric field is generated by a focused ultrafast laser pulse.

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