Air Lasing of N^{2+} Ions in a Strong Laser Field: Generation and Enhancement

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Air lasing, referring to remote mirrorless optical amplification in ambient air with the atmospheric molecules as the gain media, is a topic of intense investigation because of novel laser physics and potential application in remote sensing. Particularly, the lasing action of N^{2+} between the second excited state B and the ground state X has attracted special attention due to its mysterious physical mechanism. Here we achieve a dramatic enhancement of N^{2+} lasing emission at 391 nm [B(0)-X(0)] by two orders of the magnitude using a polarization-modulated 800-nm femtosecond laser pulse, revealing the key role of the post-ionization resonant excitation between the ground state X and the first excited state A in creating the optical gain of N^{2+}. Furthermore, on the basis of the post-ionization light-induced coupling model, we propose several novel schemes to manipulate the lasing emissions of N^{2+}.