Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Second-harmonic generation in substoichiometric silicon nitride layers EMANUELE FRANCESCO PECORA, Boston University, ANTONIO CAPRETTI, GIOVANNI MIANO, Universita degli Studi di Napoli Federico II, LUCA DAL NEGRO, Boston University — Harmonic generation in optical circuits offers the possibility to integrate wavelength converters, light amplifiers, lasers, and multiple optical signal processing devices with electronic components. Bulk silicon has a negligible second-order nonlinear optical susceptibility owing to its crystal centrosymmetry. Silicon nitride has its place in the microelectronic industry as an insulator and chemical barrier. In this work, we propose to take advantage of silicon excess in silicon nitride to increase the Second Harmonic Generation (SHG) efficiency. Thin films have been grown by reactive magnetron sputtering and their nonlinear optical properties have been studied by femtosecond pumping over a wide range of excitation wavelengths, silicon nitride stoichiometry and thermal processes. We demonstrate SHG in the visible range (375 - 450 nm) using a tunable 150 fs Ti:sapphire laser, and we optimize the SH emission at a silicon excess of 46 at.% demonstrating a maximum SHG efficiency of $4x10^{-6}$ in optimized films. Polarization properties, generation efficiency, and the second order nonlinear optical susceptibility are measured for all the investigated samples and discussed in terms of an effective theoretical model. Our findings show that the large nonlinear optical response demonstrated in optimized Si-rich silicon nitride materials can be utilized for the engineering of nonlinear optical functions and devices on a Si chip.

Emanuele Francesco Pecora
Boston University

Date submitted: 29 Nov 2012 Electronic form version 1.4