Non-linear optics and sensing with Crystalline Whispering Gallery Mode Resonators

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High quality optical resonators can store light and thus enhance the optical fields within the resonator by many orders of magnitude. High internal field intensities allow for efficient non-linear processes and narrow linewidth resonances are ideal for precise sensing applications. A particularly interesting type of resonator is the Whispering Gallery Mode (WGM) resonator, which confines light based on the principle of total internal reflection in an azimuthally symmetric dielectric. Often melting glass forms such spherical resonators, thus they rely on amorphous materials. Crystals however can feature less material absorption and provide birefringence as well as high optical non-linearities. Fabricating such crystalline resonators is however challenging. I will present our recent results on fabricating ultra-high quality \( Q > 10^8 \) magnesium fluoride resonators and coupling into them in aqueous environments. With their large evanescent field they can provide very precise bulk index of refraction sensing of the aqueous environment. Furthermore I will show how birefringent WGM resonators can show unique polarization properties if their optic axis is tilted with respect to the symmetry axis. These results open new routes for non-linear second harmonic generation in highly nonlinear lithium niobate WGM resonators.