Fiber and integrated optic elements based on microsphere resonators and meandering waveguides

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Abstract: The microspheres, with their high quality factor morphology dependent resonances (MDRs), are ideal optical resonators for three dimensional photonic lightwave circuits. In optical lightwave communication areas, such as fiber and integrated optics, the microsphere leads itself to various photonic lightwave circuit element applications such as channel dropping filters [1] tunable filters, [2] optical modulators, [3] and dynamic tuners. [4] So far we have realized these applications using silicon spheres coupled with optical fiber half couplers manufactured from single mode optical fibers. On the integrated optics side, we recently introduced distributed feedback (DFB) meandering waveguides as novel integrated optical elements. [5] We analyzed silicon on oxide (SOI) DFB meandering waveguides, which can exhibit a variety of spectral responses such as coupled resonator induced transparency filter, Fano resonator, hitless filter, Lorentzian filter, Rabi splitter, self coupled optical waveguide, and tunable power divider. In this talk, we will focus on the properties of silicon spherical resonators and SOI distributed feedback (DFB) meandering waveguides, and their potential for practical applications in fiber and integrated optics.

Keywords: coupled resonator induced transparency filter, distributed feedback (DFB), Fabry-Perot resonator, Fano resonator, hitless filter, Lorentzian filter, meandering waveguide, microsphere, microresonator, morphology dependent resonance (MDR), optoelectronics, optical resonance, photonics, silicon, Rabi splitter, self coupled optical waveguide, tunable power divider, whispering gallery mode (WGM).

1. Y.O. Yılmaz, A. Demir, A. Kurt, and A. Serpengüzel, "Optical Channel Dropping with a Silicon Microsphere," IEEE Photon. Technol. Lett. 17, 1662-1664 (2005).
2. A. Serpengüzel, A. Kurt, and U.K. Ayaz, "Silicon microspheres for electronic and photonic integration," Photon. Nanostructur.: Fundam. Appl. 6, 179–182 (2008).
3. E. Yüce, O. Gürlü, and A. Serpengüzel, "Optical Modulation with Silicon Microspheres," IEEE Photon. Technol. Lett., 21, 1481-1483 (2009).
4. E. Yüce, O. Gürlü, G.J. Thursby, and A. Serpengüzel, "Dynamical Electrical Tuning of a Silicon Microsphere: Used for Spectral Mapping of the Optical Resonances," Appl. Opt. 53, 6181-6184 (2014).
5. C. B. Dağ, M. A. Anıl, and A. Serpengüzel, "Meandering Waveguide Distributed Feedback Lightwave Circuits," J. Lightwave Technol, 33, 1691-1702 (2015).