Nonlinear optical *phononics*: Harnessing light-sound interactions in nanoscale integrated circuits

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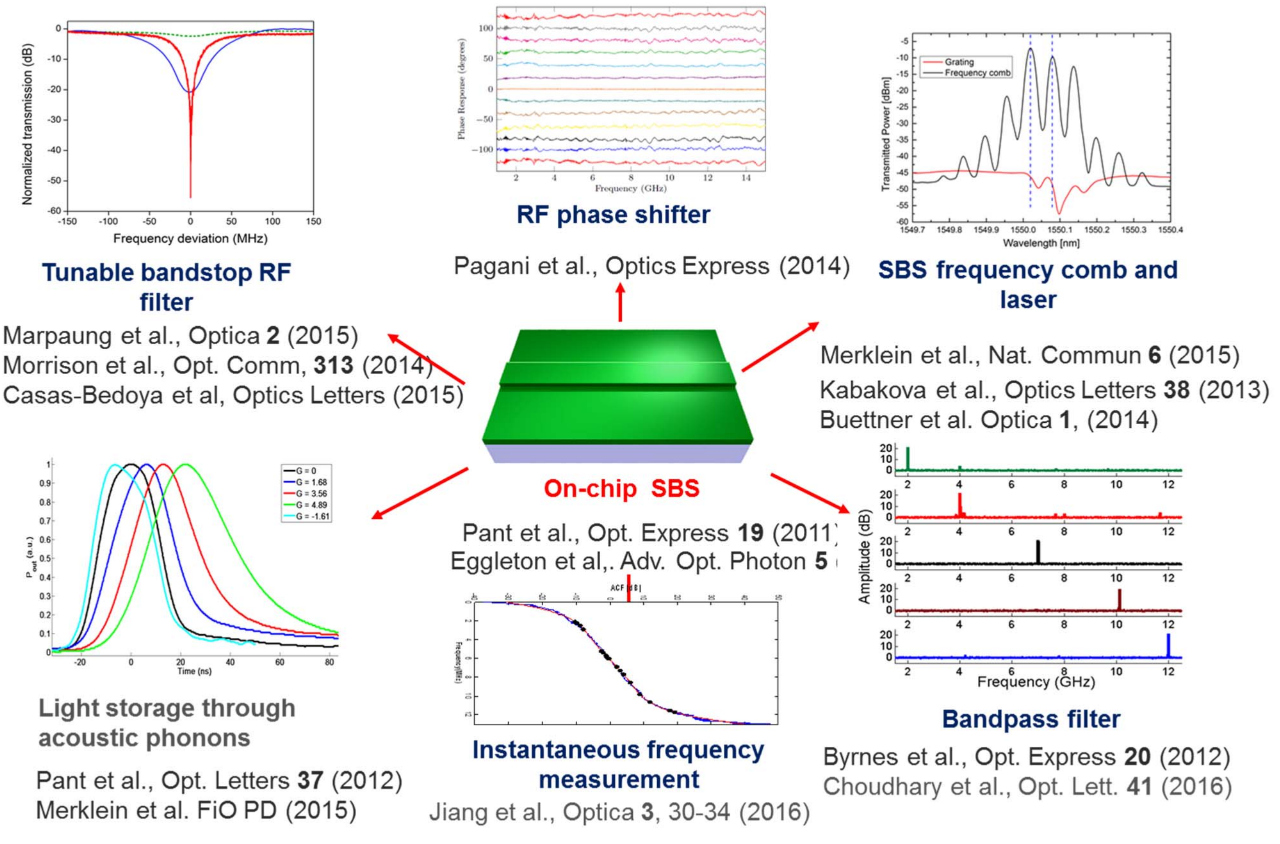
Compared to the almost magical impact of lasers and photonics on our lives, from the Internet to supermarket checkouts, mechanical systems can seem almost quaint. Yet one of the surprises of nonlinear optics – the field of optics with high intensity lasers – is that light may interact strongly with *sound*, the most mundane of mechanical vibrations. Intense laser light literally "shakes" the glass in optical fibres, exciting acoustic waves (sound) in the fibre. Under the right conditions, it leads to a positive feedback loop between light and sound termed "Stimulated Brillouin Scattering," or simply *SBS*. This nonlinear interaction can amplify or filter light waves with extreme precision in frequency (colour) which makes it uniquely suited to solve key problems in the fields of defence, biomedicine and wireless communications amongst others. SBS has been studied in optical fibres for decades; it is usually regarded as a nuisance for telecommunication and laser applications but it can also be harnessed for important applications. We achieved the first demonstration of SBS in compact chip-scale structures, carefully designed so that the optical fields and the acoustic fields are simultaneously confined and guided. This new platform has opened a range of new functionalities that are being applied in communications and defence with superior performance and compactness. This new optical-phononic chip reveals new regimes of light sound interactions at the nanoscale, which has required new theoretical developments. My talk will introduce this new field, review our progress and achievements and some of our recent highlights that point towards a new class of entirely silicon based optical phononic processor that can be manufactured in semiconductor CMOS foundries.



References

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