Group IV Photonics Platforms for Sensing Applications

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Abstract— The mid-infrared (MIR) wavelength region has attracted interest due to a host of important application areas, such as sensing, medical diagnostics, industrial control, communications, defence and security [1, 2]. Of particular importance is the so-called 'fingerprint' region where high selectivity sensing can be achieved. Integrated, compact, low cost and low energy solutions in group IV materials will have significant advantages over expensive and bulky spectrometers currently used.

Due to absorption properties of photonic materials [3], variety of potential applications and several fabrication issues in the MIR, different material platforms need to be considered for this wavelength range. In the last 3 years, MIR devices in SOI [4, 5], SOS [6], Si on porous Si (SiPSi) [7], and Geon-Si [8] have been reported. SOI platform is probably the most desirable, as it has been extensively used for telecommunication wavelengths and fabrication recipes and designed rules are mature and can be readily transferred to the MIR. We have investigated this platform up to 4 μm and showed that the propagation loss can as low as 3 dB/cm for 400 nm thick SOI waveguides and at the wavelength of 3.8 μm. We have also demonstrated passive components based on this structure, including multimode interference (MMI) splitters, ring resonators, Mach-Zehnder interferometers (MZIs) [4], and spectrometers [9].

In order to extend the operational wavelength range even further, we have examined suspended structures in which the buried oxide layer has been removed [5]. Our simulations show that this structure can be used up to 6.5 μm for the Si overlayer thickness of 500 nm [10]. For the fingerprint region, the most promising candidate is Ge, and different Ge-based platforms can be considered.

ACKNOWLEDGMENT

This work has been supported by the Royal Society (Goran Mashanovich's URF "Mid-infrared Silicon Photonics") and by EPSRC through "UK Silicon Photonics" programme.

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Session 3A9a
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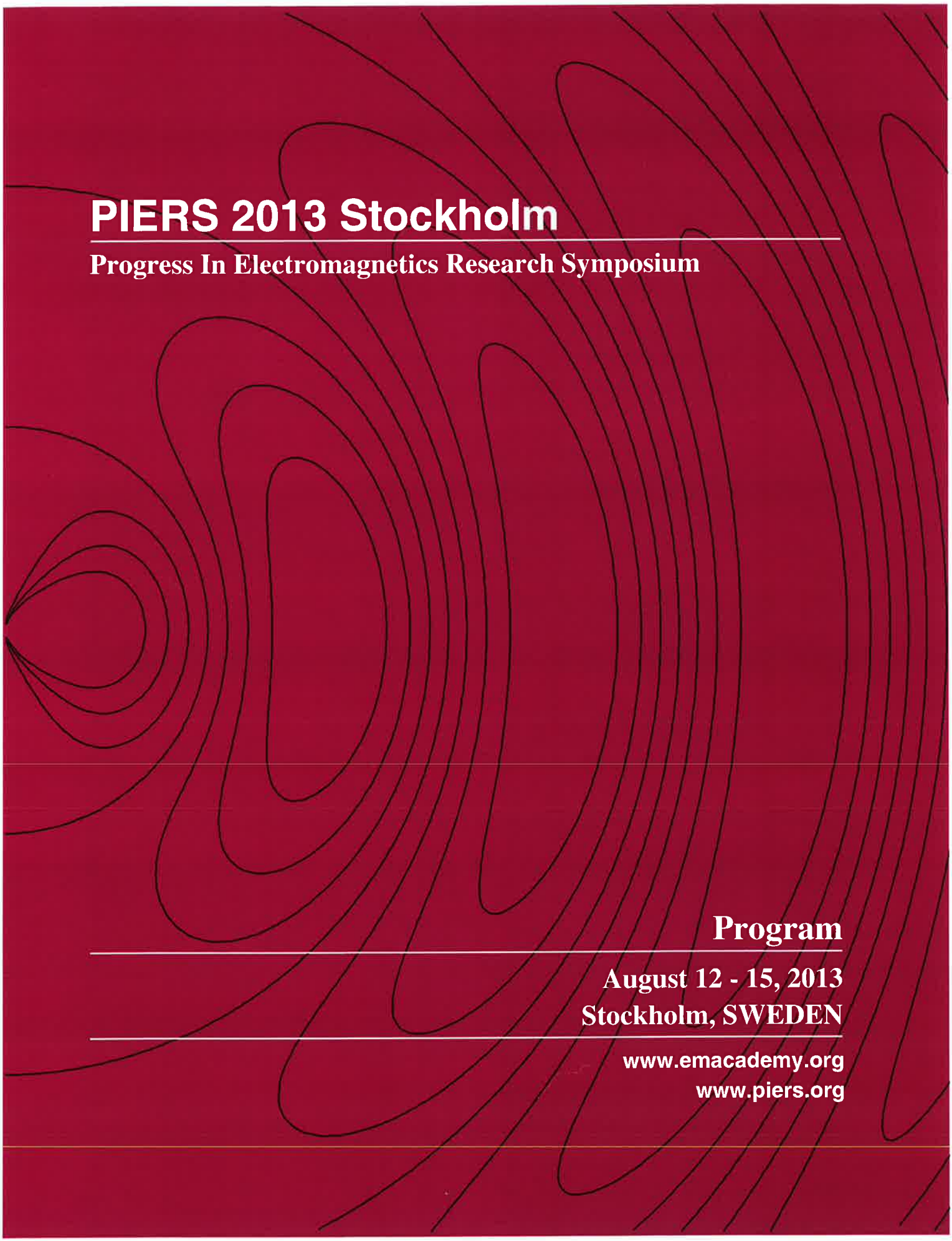

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