Silicon photonics technology is becoming more and more competitive with regard to other alternative platforms, being its suitability for electronics integration and cost-efficient the most appealing features. Implementing nonlinear functions in silicon photonics, e.g. switching or routing, has attracted significant interest since they allow, for example, to boost the switching speed compared to electrically-controlled switched. Many different active and nonlinear silicon photonic nonlinear functions have been recently reported such as all-optical modulators, [1] wavelength converters, [2] and parametric amplifiers [3]. Moreover, all of them may be easily integrated to generate more complex devices within a small area thanks to the high refractive index of silicon.

The main drawback of silicon for realizing nonlinear functionalities at telecom wavelength (around 1550 nm) is two-photon absorption (TPA) effect, not only because of the lost photons in the process but also because the generated carriers subsequently produce undesired free carrier absorption (FCA) and dispersion (FCD). As the Kerr response of the device is determined by *Ref*g *g* and TPA is given by *Imf*g *g*, a TPA figure-of-merit (FOM) can be defined as *Ref*g *g=*(4p*jImf*g *gj*). The latter provides an useful dimensionless measurement of the suitability of the material for nonlinear switching, where it is usually considered as suitable if this number is greater than two [4]. Bulk crystalline silicon has a FOM of *'*0.35 [5], therefore SOI waveguides have a limited FOM close to that number depending on the waveguide geometry and polarization. This Is the reason why a material different from crystalline silicon is needed.

Amorphous silicon (a-Si) has been demonstrated to have a high nonlinear coefficient [6] and low TPA thanks to its wider band-gap [7]. Furthermore, it is a material that can be easily grown in CMOS compatible processes. As a-Si does not need high annealing temperatures it is a good candidate for all-optical interconnects in between different chips and it could be grown on a top layer not affecting circuits already integrated on the chip.

On the other hand, a-Si does not always have the same optical properties, as its composition

(*i.e.* hydrogen content) or atomic arrangement can vary depending on the fabrication conditions.

In Ref. [6] a *Ref*g *g'*2000(*Wm*)1 nonlinear coefficient was presented, but TPA was also high,

leading to a figure of merit of 0.66. However, in Ref. [8], a FOM larger than two was reported.

In [8] a degradation of the material within minutes of light exposure was also reported.

Here, we report the characterization of the real and imaginary parts of g of a-Si samples

with a FOM of 4.9 and no observed material degradation.

**Conclusions**

We have reported the nonlinear characterization of the real and imaginary parts of g of a-Si samples, and a comparison with SOI waveguides is also performed. The measured FOM is 4.9, which is more than 7 times higher than for the SOI samples. As a-Si can be grown in the back-end of a CMOS fabrication process, rather than SOI, it is a suitable candidate for nonlinear all-optical switching applications.