

4. Conclusions

The linear and nonlinear coefficients from the hydrogenated amorphous silicon photonic nanowires were extracted in this paper. The linear absorption was found to be 3.6 dB/cm while the nonlinear parameter was found to be $\gamma = 770 - j28 \text{ W}^{-1}\text{m}^{-1}$ after exposing the waveguides for 30 minutes. This results in a figure of merit larger than 2. The carrier lifetime was estimated to be $1.87 \pm 0.1 \text{ ns}$. The potential of the a-Si:H photonic nanowires for all-optical nonlinear processing was demonstrated by a 320 Gbit/s waveform sampling experiment. The intrinsic FWM conversion efficiency in this experiment was +12 dB. This is an improvement of 19.5 dB as compared to similar sampling experiments in c-Si [19]. The degradation of the hydrogenated amorphous silicon layers is discussed. This degradation is presumably caused by a process similar to the Staebler-Wronski effect in amorphous silicon solar cells. As with the Staebler-Wronski effect in amorphous silicon cells, the degradation can be reversed by thermally annealing the sample. This was demonstrated by heating the sample for half an hour at 200 °C. Improving the stability, for example by increasing the bandgap, could make the hydrogenated amorphous silicon photonic nanowires the platform for nonlinear integrated optics in the telecommunication wavelength range.

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