Supplementary material: C-Si hybrid photonic structures by full infiltration of conjugated polymers into porous silicon rugate filters

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I. DEPTH PROFILE OF THE RUGATE FILTER

Figure S1 shows a profile of the TEM micrograph shown in the main text in figure 1(b). Here, the maxima correspond to the brighter layer, whereas the minima are the darker layers. In this way it is therefore possible to evaluate the interplanar distance as the spacing between two minima (or two maxima). This average spacing is found to be ~150 nm, in excellent agreement with the two-dimensional fast-Fourier-transform (2D-FFT) data. To provide statistical information on the distribution of periods etc., we have also carried out a full fast-Fourier-transform (FFT) analysis of 5 depth profiles taken from figure 1b.

Figure S1. Profile of the internal structure extracted from figure 1(b) of the main text.

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We have also tried to fit with a sinusoid a section of the profile number #5. The poor fitting ($R^2=0.7$) highlights the differences with respect to a pure sinusoidal wave.

![Graph showing sinusoidal fit vs profile](image)

**Figure S2.** Comparison between a sinusoidal function with the profile extracted from figure 1(b)

**II. ATOMIC FORCE MICROSCOPY (AFM) CROSS-SECTION IMAGE**

We show in figure S2 an AFM cross section of the rugate filter at the interface between untreated silicon and the pores. In the bulk silicon we can see the cleavage plane. From observation the size of pores is not uniform, but mostly in the range of 40-100 nm.

![AFM cross section image](image)

**Figure S3** Bottom part of the rugate filter (columnar top part of the image) and the untreated bulk silicon (bottom part of the image).
III. ANGLE-RESOLVED SPECTROSCOPY

Figure S4 Contour plot of the angle resolved reflectance spectra for the tuned PhC before a) and after (b) polymer infiltration. The angular dispersion and the width of the stop-band are not affected by the presence of the polymer. After polymer infiltration the stop-band is red-shifted of about 12 nm.

Figure S5 Contour plot of the angle resolved reflectance spectra for the detuned PhC before a) and after (b) polymer infiltration. The angular dispersion and the width of the stop-band are not affected by the presence of the polymer. After polymer infiltration the stop-band is red-shifted of about 16 nm.

The apparent oscillating behaviour of the secondary reflectance fringes in Fig. S4 or the non-dispersive one on Fig. S5 is actually a visual/optical effect due to the fact that there are many (similar) fringes shifting with angle, and that at some point it is hard to follow the fringe of the same order when passing from one spectrum to the next.

We illustrate this "trompe l'oeil" effect by looking at the actual spectra taken (and from which the contour plots were derived) and reported below in Fig. S6 for both the tuned (a) and detuned (b) sample before polymer infiltration. Here, the fringes have a normal/expected blue-shift as a function of angle. To make it more obvious we have now highlighted the evolution with angle by focusing on the 10th fringe and the 3rd for from the main stop-band peak for the tuned and detuned sample, respectively (marked with a square as far as possible, as beyond a certain angle some of the intermediate fringes cannot be identified). To sum up, the visual effect in the contour plot is due to the shift of 1 entire period, and thus this would appear as a shift in the opposite direction, instead of a real blue-shift.
Figure S6 Angle resolved reflectance spectra for the tuned (a) and detuned (b) PhC before polymer infiltration. In both cases there is a blue shift of both the main reflectance peaks and the secondary fringes.

Figure S7 Contour plots of the PL spectra as a function of the incidence angle for the F8BT infiltrated into the tuned (a) and detuned (b) PhC.

IV. TIME RESOLVED PHOTOLUMINESCENCE

| Single Exp. | $\chi^2$ |
|-------------|----------|
| High-energy edge |          |
| Film on Si | 1150±57 | 1.496  |
| Stop-band  | 1180±57 | 1.800  |

Figure S1 Temporal decay constant ($\tau$) extracted from mono-exponential fits of the PL decay curves of the F8BT neat film with their reduced $\chi^2$. 