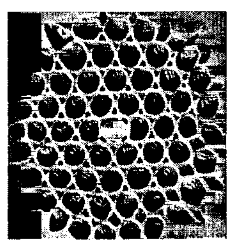
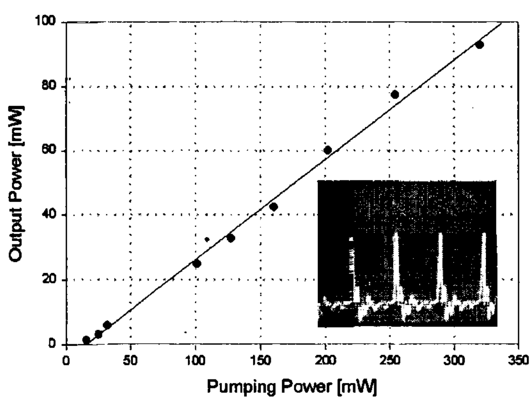
Development and applications of ytterbium-doped highly nonlinear holey optical fibres

K.Furusawa, J.H.V.Price, T.M.Monro, P.Petropoulos and D.J.Richardson
Optoelectronics Research Centre, University of Southampton, UK
Tel: +44(0) 23-8059-7673 Fax: +44(0) 23-8059-3149 Email: kf@orc.soton.ac.uk

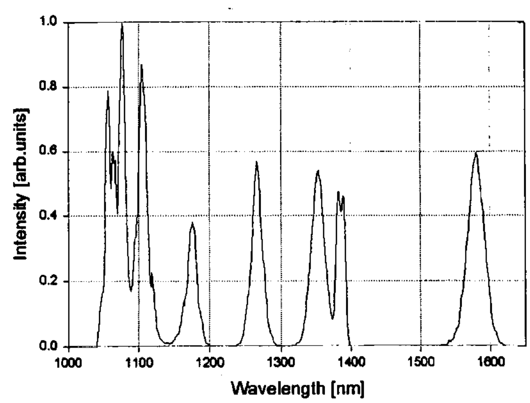
We have fabricated an ytterbium doped holey fibre with an effective area of just $2.5\mu m^2$ at the laser wavelength ($1.03\mu m$) as shown in Fig.1(a). The fibres display huge birefringence at $1.55\mu m$ (beat length 0.3mm) owing to the high index contrast between the core and the cladding, the small dimensions, and the elliptical core shape. Using this fibre, we have demonstrated a low threshold and environmentally stable mode-locked laser using frequency feedback technique (see Fig.1(b)). Furthermore, the fibre exhibits anomalous dispersion at the laser wavelength. Using this feature along with the high nonlinearity, we have also demonstrated broadly and continuously tunable Raman soliton generation by seeding with only pico-joule femtosecond pulses into the fibre. In a single pulse regime, the tuning range covers from 1.06 to $1.33\mu m$, a region that is difficult to access using conventional solid state laser technology. In a multiple pulse regime, we have obtained femtosecond pulses as long as $1.58\mu m$ as shown in Fig.1(c).



(a)



(b)



(c)

Figure 1: (a) SEM of the ytterbium holey fibre. (b) Output characteristics of the mode-locked ytterbium holey fibre laser. (c) Output spectrum at high pump power.