PASSIVE MODELOCKING OF A CW DYE LASER IN THE YELLOW SPECTRAL REGION

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The passive modelocking of a cw rhodamine 6G dye laser over the spectral range 570 to 600 nm using 2-(p-dimethylamino styryl)-benzthiazolylethyl iodide (DASBTI) as the saturable absorber is reported. In a simple linear cavity with broad band reflecting mirrors, pulses as short as 520 fs were measured using standard second harmonic generation autocorrelation techniques.

Much recent interest has been shown in the generation of femtosecond optical pulses from passively modelocked CW dye lasers. These systems allow the generation of shorter pulses of higher amplitude stability and improved interpulse jitter characteristics compared to their synchronously and hybridly modelocked counterparts.

To date, however, most of the reported work has been limited to the spectral region around 615 nm and has employed Rhodamine 6G as the gain medium and DODCI as the saturable absorber [1-5]. In an optimised cavity this combination has allowed the direct generation of pulses as short as 27 fs [6]. Recently we have reported on the passive modelocking of the highly efficient dye Rhodamine 700, tunable in the near infrared region of the spectrum [7]. In addition at 554 nm, long (~5–7 ps) passively modelocked pulses have been observed by Ruddock with sodium fluorescein as the active medium and Rhodamine 6G as the absorber [8]. These latter two systems represent the only reported passively modelocked CW dye laser sources outside the "common" 600–625 nm wavelength range.

We report here on the extension of purely passive CW modelocking to allow stable subpicosecond pulse generation tunable from ~570–600 nm, using the dye DASBTI (2-(p-dimethylamino styryl)-benzthiazolyl ethyl iodide) as the saturable absorber in a Rhodamine 6G dye laser. DASBTI has previously been employed as a saturable absorber in quasicontinuous flashlamp-pumped dye lasers [9]. The absorption spectrum of a 3:1 ethylene glycol:ethanol solution of the dye is shown in fig. 1, with a measured peak extinction coefficient of $e_{\text{max}} = 7.18 \times 10^4 \text{ cm}^{-1}$ at 535 nm.

The experimental arrangement is shown in fig. 2. This comprised of a five mirror cavity design which...
Fig. 2. Cavity configuration.

Fig. 3. Autocorrelation traces of passively modelocked pulses at (a) 595 and (b) 573 nm.

The pulse durations were measured using the standard collinear SHG autocorrelation technique. Using a real time autocorrelator, the output pulses were optimised and hard copies of the autocorrelation were taken using a slow scan. For wavelengths above 590 nm LiIO₃ was used as the SHG crystal, while below 590 nm KDP was used. Figs. 3(a) and (b) shows autocorrelation traces of pulses recorded at 595 nm and 573 nm respectively. Using the real time autocorrelator, subpicosecond pulse durations were observed over the range 570–600 nm. All the autocorrelation traces obtained showed the 3:1 contrast ratio necessary for complete modelocking. However, a spectral investigation revealed that the pulses were not transform limited (the 2.2 nm measured bandwidth capable of supporting 0.16 ps pulses) possessing some frequency chirp. This chirp may well be due to the broad band “double stack” dielectric mirror coatings [11,12].

In conclusion, we have demonstrated passive modelocking in the yellow spectral region using the saturable absorber DASBTI. We are confident that in a cavity possessing no tuning wedge and with carefully selected single-stack mirror coatings it will be possible to generate transform limited pulses of less than 100 fs duration over the tuning range presented here. This tuning range is limited in the yellow by the available gain in our system. We are currently investigating alternative active and passive dye combinations to further extend...
the range of purely passive modelocking in the shorter wavelength region of the spectrum and additionally to the infrared.

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References