FREQUENCY STABILIZATION OF HIGH-POWER 3.3 μm CW LASER WITH A FREQUENCY COMB SYSTEM

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The development of optical frequency combs has enabled a broad range of lasers to be stabilized. In this study, we have developed a system to stabilize high-power CW mid-infrared (MIR) radiation at 3.3 μm using a NIR-VIS frequency comb. The mid-infrared radiation at 3.3 μm were generated as an idler of a CW OPO laser pumped by a 1.064 μm fibre laser. To stabilize the MIR radiation with a frequency comb system in 450 nm to 1.25 μm range, the pump frequency at 1.064 μm and the sum frequency of the MIR radiation and the pump radiation were locked simultaneously to the comb laser. The sum frequency of the MIR and pump radiations was generated in a PPLN crystal. With this technique, we have successfully obtained a width of better than 50 kHz at 3.3 μm with a power of more than 1 W. The stability is currently limited by the response of the PZT in an OPO cavity. Further improvement is underway. The stabilized MIR radiation at 3.3 μm can be used as a source for ultra-high-resolution spectroscopy of vibration-rotation transitions of molecules. Especially, it may be used to decrease the frequency uncertainty of the ν_3 $F_2^{(2)}$ component of the P(7) transition of CH_4, which is one of the optical frequency standards recommended by CIPM. Another application of frequency stabilized MIR radiation is to build-up MIR radiation in a cavity for optical manipulation and trapping of cold molecules we have proposed in *New. J. Phys.* 11. 055023 (2009).