Incoherent Broadband Cavity Enhanced Absorption Spectroscopy with a Supercontinuum Source

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Broadband cavity enhanced absorption spectroscopy can be used to perform detection of gases with a very high sensitivity due to the very long optical path of the cavity [1]. Compared to coherent methods, cavity enhanced absorption spectroscopy is simpler and more robust allowing to readily perform in-situ measurements. Supercontinuum sources on the other hand possess unique properties in terms of brightness and spatial coherence that make them particularly suitable for a wide range of applications ranging from spectroscopy to imaging and chemical sensing [2].

Here we demonstrate incoherent broadband cavity enhanced absorption spectroscopy in the near-IR/mid-IR wavelength range using a specifically developed supercontinuum source. The source is based on a gain-switched nanosecond fiber laser operating at 1545 nm and a silica-based dispersion shifted fiber to produce a supercontinuum spectrum that extends beyond 2 microns. A fluoride fiber possessing low absorption in the mid-IR range can be added to extend the spectrum up to 3.5 microns with an average power up to 160 mW. Using near-confocal cavity with mirrors with high reflectivity we measure the absorption spectrum of methane with a high accuracy. Our technique has the potential to perform selective multi-component measurement with extreme sensitivity in the near/mid-IR spectral range.

Fig. 1. (a) Generated supercontinuum spectrum extending up to 3.5 microns. (b) Experimental setup for incoherent broadband cavity enhanced spectroscopy.

References