

## Fibre optic grating sensors for Biofuels

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### ABSTRACT

Biofuels will have more intense impact on the energetic grid of the planet, because known fossil fuels reserves are being exhausted. The biofuel production relies on the transformation process of some organic material in the desired hydrocarbon product. Because of the natural characteristics of the related processes, fibre optic sensors appear to be adequate candidates to be used.

**Keywords:** Bragg grating, long period grating, sensors, biofuel.

### 1. INTRODUCTION

The use of fossil fuels in the energetic matrix of Earth puts a severe stress in social & economic development, due to rising costs derived from extraction complexity, reserves exhaustion and producer's threats. Fossil fuels still have a large share on the energy supply in most countries. On the other hand, the increasing volume of organic waste generated by today's consumer society also imposes stress on the waste management services, storage and safe elimination of potentially hazardous pollutants. Biofuels are a possible solution to reduce part of the associated problems in both subjects.

Biofuels are combustible materials derived from organic matter. They can be solid biomass, replacing wood or carbon coal in standard ovens, liquid fuel – as the ethanol (ethyl alcohol) used in Brazil for propelling vehicles, or biogases – obtained, e.g., from fermentation and chemical decomposition of organic residues. It long was recognized by non governmental organizations that small scale biofuel plants can improve social development in less favoured regions of the World. However, developed countries would require large scale biofuel plants. One successful example is the Brazilian use of ethanol for vehicle propulsion, which drives large areas to sugar cane planting, large scale ethanol processing units and country wide distribution and commercialization of the product. Due to its widespread use in Brazilian automobiles & trucks, the commercialization of ethanol reached the neighbouring countries in Latin America.

Sensing necessities for biofuel production and distribution chain are similar to those needed for petroleum & gas processing. Fibre optic sensors have obvious advantages over conventional sensors in several aspects like, e.g., being electrically passive, high level of chemical inertness, low mass & volume, immunity to electromagnetic pick up generated by huge motors, generators and moving parts. Some standard use of fibre optic sensors is already disseminated in such activities like the strain monitoring using Bragg grating sensors. Other important sensing area is temperature monitoring. Although Bragg gratings have a potential application for that, the present status of commercial sensing systems is limited for temperature applications in industrial environment. The main drawback, up to now, of Bragg grating sensing is the thermal decay of the gratings, which reduces their lifetime at temperatures higher than a few hundreds of degrees. Industrial needs usually require 500-1000 °C. This is a fertile research area and several papers in this workshop deals with gratings for higher temperature range. However, there are still open niches in the market for other suitable sensors.

Our group at UTFPR started to work on application of fibre gratings to biofuels as soon as recording the first gratings. Both Bragg gratings and long period gratings were studied for sensing purposes. A short review of the obtained results is presented here.

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