Enhanced fiber mounting and etching technique for optimized optical power transmission at critical cladding thickness for fiber-sensing application

ABSTRACT

Optical fibers offer various applications to cater to industrial needs, from power and data transmission to environmental sensing. Different sensing mechanisms of optical fibers depend on modifications made to the fiber itself primarily in the cladding and core sections. Different types of optical fiber sensors may require thinning of the cladding to allow propagated light to interact closer to the environmental stimuli. Chemical etching is commonly used for the de-cladding of a fiber, and there are many ways to execute this method. A conventional method of chemical etching is typically used for cladding removal. This paper reports and discusses the effectiveness of enhanced techniques for improvement towards conventional chemical etching methods with the assistance of a makeshift fiber holder. The fiber holder allows the fiber to be oriented well, allowing for smoother etching and thus conserving its mechanical structure. Thickness reduction is seen to be more consistent when the enhanced technique is employed, and the fiber takes a longer time (~45 min) to break. This allows etching of the cladding close to the core, which is more manageable for the user if very thin cladding is required. A fiber etched without any holder tends to break earlier (~35 min) than expected with a rather wide error margin. The lower coefficient of determination, R2 values (95%) of the thickness reduction from conventional etching shows irregular thickness along the fibers. Optical power also fluctuates between 30–35 dBm for the conventional method, while the mounted fiber technique maintains stable optical power at 50 dBm during etching. Therefore, it is concluded that proper fiber horizontal fiber orientation during etching has a significant effect on the fiber strength due to the smooth cladding removal around the corecore while minimizing any permanent power loss to or the occurrence of fluctuations in the fiber. This smooth and efficient etching technique allows the production of enhanced fiber sensors with minimal structural or power defects.