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FBG-based diagnostics for large vacuum machines

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In terms of the increasing complexity of fundamental research topics at accelerators the requirements concerning the experimental setup of these large vacuum machines gain more and more impact. One crucial aspect to fulfil these experimental requirements is the necessity of monitoring and capturing the process parameters of the accelerator itself, like temperature or position of vacuum components at different stages inside the accelerator. Due to the large size of an accelerator an effective diagnostic has to be centralized, which ends up in large signal paths of several hundreds of meter. Therefore, the diagnostic signal has to be robust and sensitive enough to avoid external impact and to observe small changes in temperature or position. In addition, to access the differently shaped vacuum components easily, both flexible and local positioning of the sensor inside the vacuum machine is required.

The present contribution concentrates on a fiber-based diagnostic method inside large vacuum machines. The sensors are based on fiber Bragg gratings (FBGs), which are narrow linewidth filters integrated in an optical fiber. The sensors have a length of several mm (typically 8mm). The advantage is that they are immune against electromagnetic radiation and tens or hundreds of sensors can be easily multiplexed. The FBGs are very sensitive to strain and temperature. In combination with a hermetical sealed optical fiber feedthrough, an optical fiber containing a bunch of several FBGs becomes a compact, stable, robust, and flexible network of local sensors to simultaneously monitor and capture process parameters at different positions inside vacuum machines. In the present contribution, a discussion about FBG-based sensors as an ideal sensor network inside the vacuum is stimulated.

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