

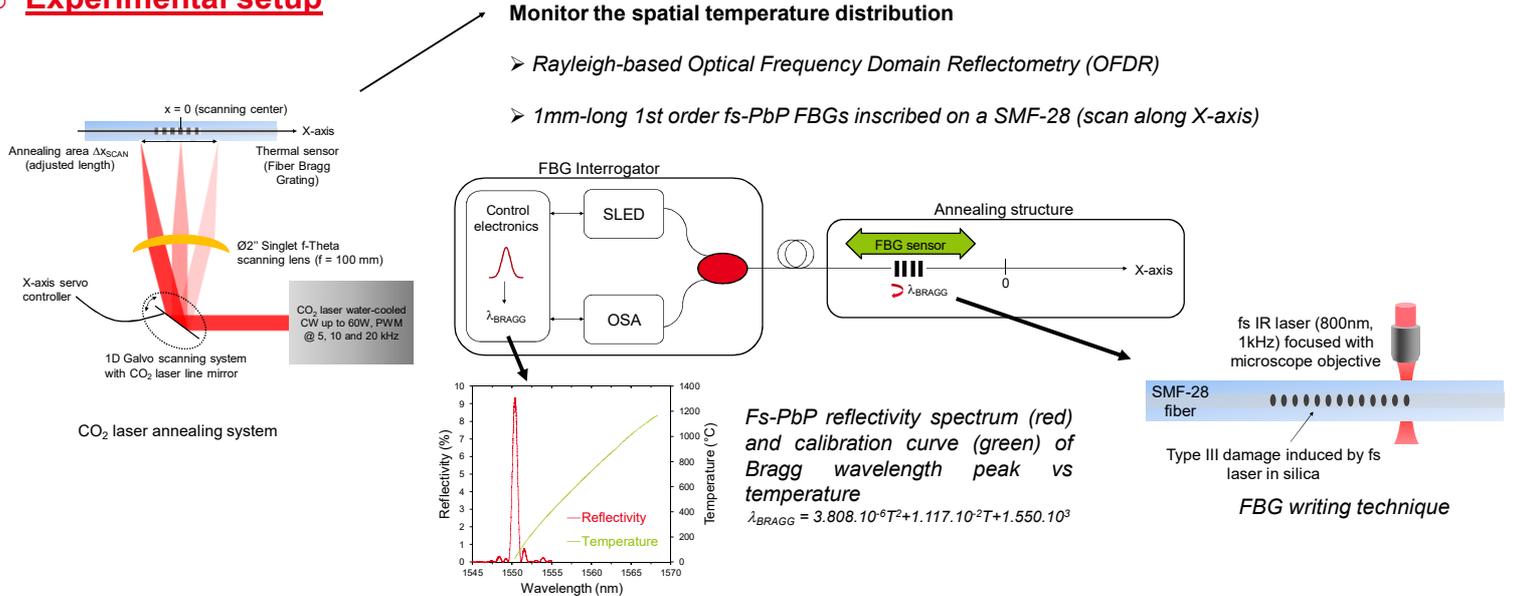


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ABSTRACT : This poster presents the development of a CO₂ laser-based heating system to simulate fast thermal phenomena on high temperature resistant FBGs dedicated to high temperature profiles monitoring within components exposed to hot plasma inside Tokamak. We have demonstrated the reliability of two optical fiber based sensing techniques to control spatial and temporal annealing measurement during high and fast thermal process.

MONITORING OF SINGLE-MODE FIBER LASER HEATING USING RAYLEIGH SCATTERING AND 1ST ORDER FS-PbP FIBER BRAGG GRATING

Experimental setup

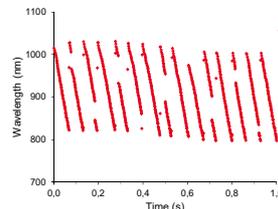
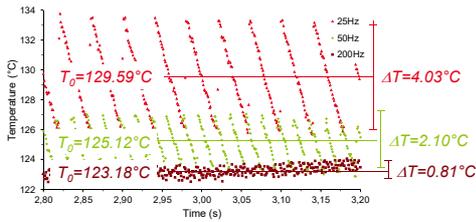


Results and discussions

Temporal annealing parameters (fs-PbP FBG monitoring)

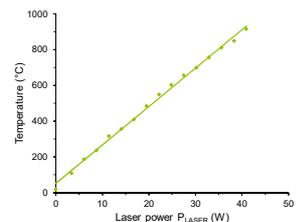
High frequency temperature measurements using a 1kHz spectrometer integrated at CEA LIST.

Annealing parameters: scan movement: sinus+gating signal, $f_{SCAN}=100\text{Hz}$, position $X=0$, $\Delta X_{SCAN}=14\text{mm}$, $P_{LASER}=10\text{W}$ and $f_{CO2}=20\text{kHz}$



High frequency temperature measurements Annealing parameters: scan movement: sinus+gating signal, $f_{SCAN}=15\text{Hz}$, position $X=0$, $\Delta X_{SCAN}=14\text{mm}$, $P_{LASER}=42.5\text{W}$ and $f_{CO2}=20\text{kHz}$

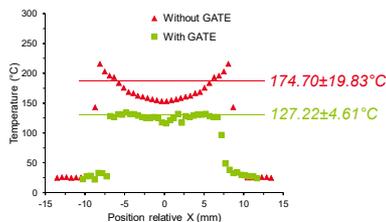
High frequency temperature measurements Annealing parameters: scan movement: sinus+gating signal, $f_{SCAN}=100\text{Hz}$, position $X=0$, $\Delta X_{SCAN}=14\text{mm}$ and $f_{CO2}=20\text{kHz}$.



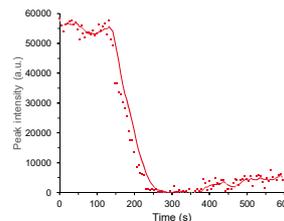
Spatial annealing parameters (LUNA ODISI monitoring)

Thermal profil along x-axis using CO₂ laser annealing, without gating signal (red) and with gating signal (green).

Annealing parameters: scan movement: sinus/sinus+gating (single pass), $f_{SCAN}=100\text{Hz}$, $\Delta X_{SCAN}=16\text{mm}$, $P_{LASER}=6\text{W}$ and $f_{CO2}=20\text{kHz}$



Application : Regenerated Fiber Bragg Grating (fs-PbP FBG monitoring)



Regeneration of FBG using CO₂ laser annealing. Annealing parameters: scan movement: sinus+gating signal, $f_{SCAN}=100\text{Hz}$, $\Delta X_{SCAN}=14\text{mm}$, $P_{LASER}<40\text{W}$ and $f_{CO2}=20\text{kHz}$

Conclusion

In this work, we show the development of a CO₂ laser-based heating system to simulate fast thermal effect such as those expected from the hot plasma creation within a Tokamak. To monitor and optimize the spatial distribution along the scanned area, we use two processes based on optical fiber, one is based on Rayleigh scattering distributed sensing and the second one is based on a 1mm-long 1st-order fs-PbP FBG. The second technique can be coupled to 1 kHz spectrometer to study temporal distribution. After optimization of this heating process, we demonstrate the use of this laser heating setup to regenerate a FBG. Such a setup will also give us insight into the impact of thermal shocks on the behavior and reliability of the transducer.