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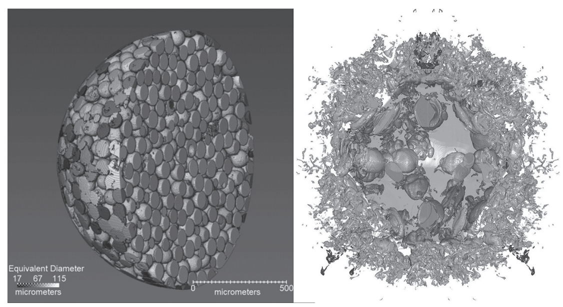
Method using gas-containing plastic foams helps determine how heterogeneity affects burn rates in thermonuclear fusion.



One way to achieve nuclear fusion energy is to use lasers to heat and compress deuterium and tritium fuel to incredibly high temperatures and pressures inside small volumes called “hot spots”. This process, however, can fold undesired material into the hot spot, diluting and cooling the fuel as the contaminants mix with the deuterium and tritium. Albright et al. developed a method to understand how incomplete mixing of these contaminants can change the burn rate of thermonuclear fusion.

In the study, the authors measured deuterium-tritium fusion in experiments that showed how incomplete mix changes the rate of energy release of a thermonuclear system. They corroborated their results with computer simulations, which mark the first time this complex behavior was accurately modeled with a sub-grid turbulent mix model, as well as with high-resolution numerical simulations.

“This work reports on the first high-quality quantitative data on the role of mix heterogeneity (i.e., incomplete mixing) in affecting thermonuclear burn,” co-author Brian Albright said. “These data are being used to validate our mix and burn models, providing us with increased confidence in their ability to model high energy density burning plasmas.”

To study thermonuclear burn, the researchers developed foams made with deuterium – concentrated in the foams’ bodies – and tritium gas – concentrated in the foams’ pores. They then imploded the foams, trapped within capsules, with a laser so the materials mixed and burned. By varying the pore sizes of the foams, the team could control and measure the effects of incomplete mixing on thermonuclear burn rates.

The authors plan follow-on work to better understand the behavior they observed in their experiments.

Source: “Experimental quantification of the impact of heterogeneous mix on thermonuclear burn,” by B. J. Albright, T. J. Murphy, B. M. Haines, M. R. Douglas, J. H. Cooley, T. H. Day, N. A. Denissen, C. Di Stefano, P. Donovan, S. L. Edwards, J. Fincke, L. M. Green, L. Goodwin, R. A. Gore, M. A. Gunderson, J. R. Haack, C. E. Hamilton, E. P. Hartouni, N. V. Kabadi, S. Khan, P. M. Kozlowski, Y. Kim, M. N. Lee, R. Lester, T. Morrow, J. A. Oertel, R. E. Olson, B. M. Patterson, T. Quintana, R. B. Randolph, D. W. Schmidt, R. C. Shah, J. M. Smidt, A. Strickland, C. Wilson, and L. Yin, *Physics of Plasmas* (2022). The article can be accessed at https://doi.org/10.1063/5.0082344.

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