Jason Trelewicz and Lance Snead, Stony Brook
Advanced Moderator Development for Reduced EPZ

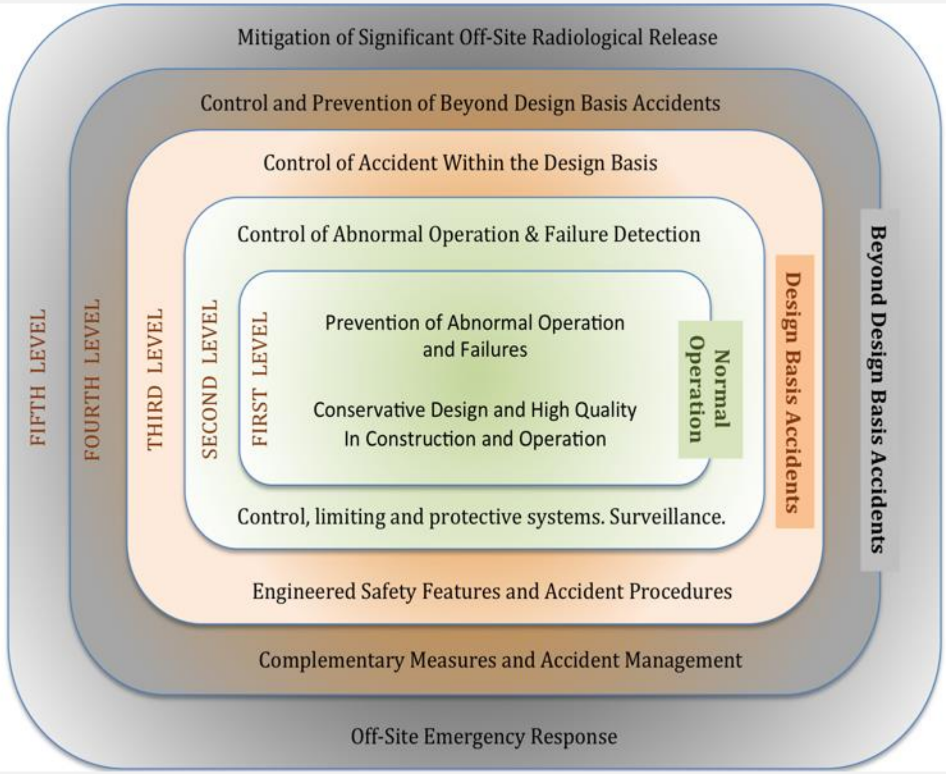
Team members
- *Professor Nick Brown and Caen Ang, UTK*
- *Drs Xunxiang Hu and Yutai Katoh, ORNL*
- *Professor David Sprouster, Stony Brook*

Goal
- *To develop and mature high-temperature, highly moderating materials for SMR application.*

What is the technology?
- *Engineered, two-phase moderators*
  - matrix phase: good moderation
  structural integrity
  - entrained phase: high moderation

• Radiation stable, lifetime components operating at > 600°C.

- *A practical route to reducing cost lies in simplification and ultimate safety. Technologies enabling this include:*
  - Zero release fuel form (FCM-SiC/TRISO)
  - Core conduction to ambient under LOCA
  - Compact, lifetime SMR.
  - Replace core graphite with high performance moderator



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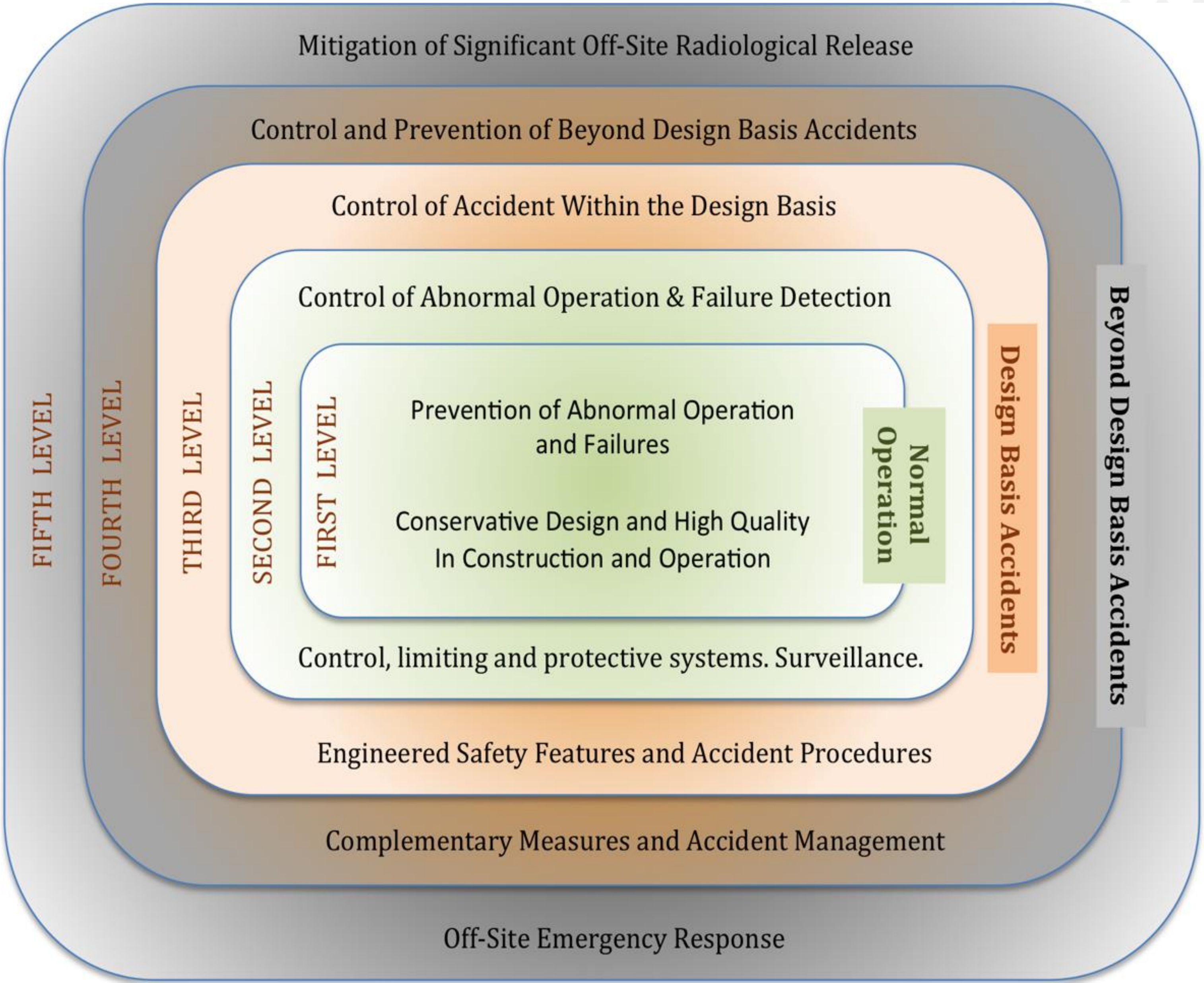

Contents lists available at ScienceDirect

Current Opinion in Solid State and Materials Science

journal homepage: www.elsevier.com/locate/cossms

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Motivation for utilizing new high-performance advanced materials in nuclear energy systems

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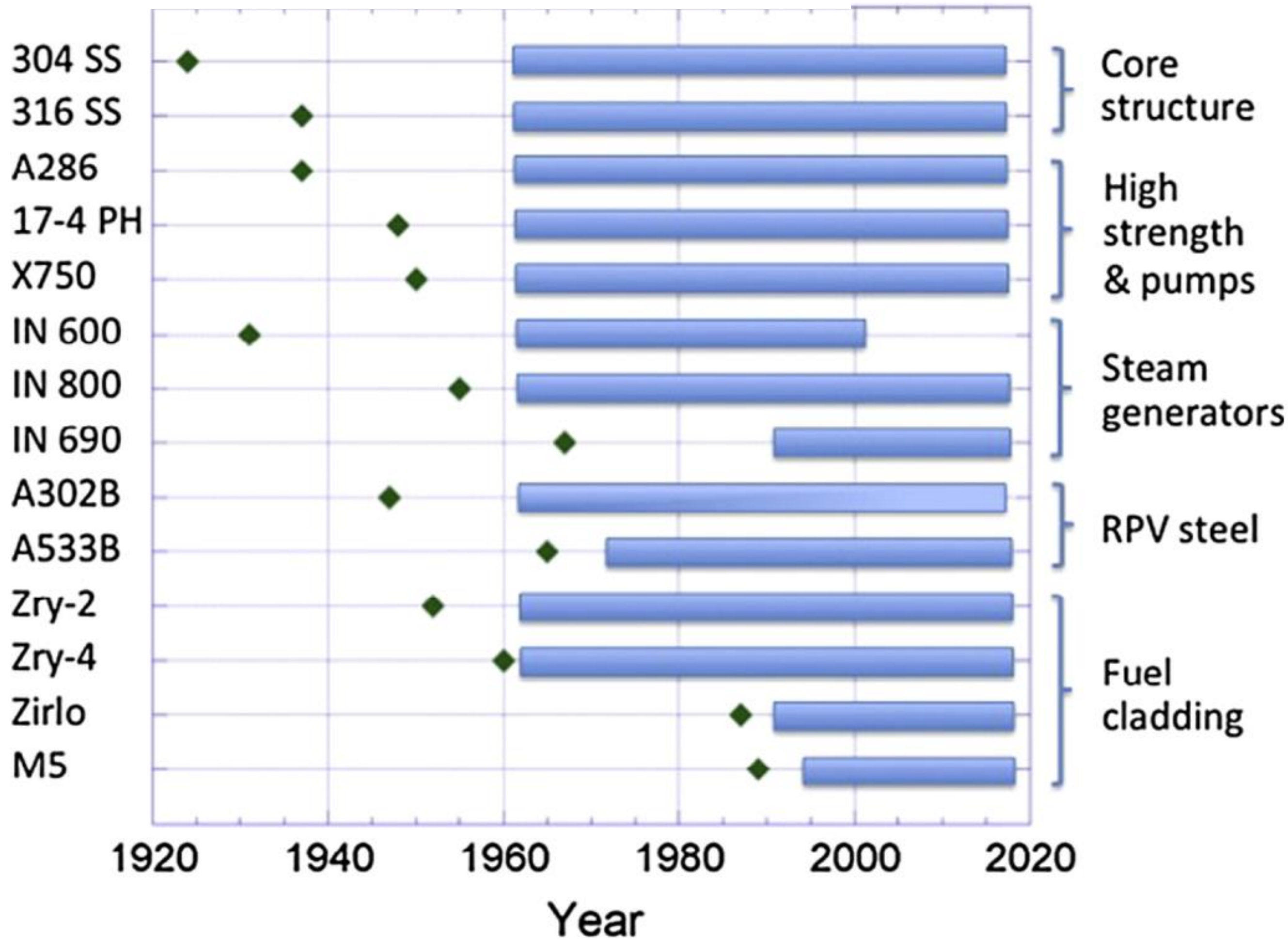
COSSMS 2016



CHANGING WHAT'S POSSIBLE

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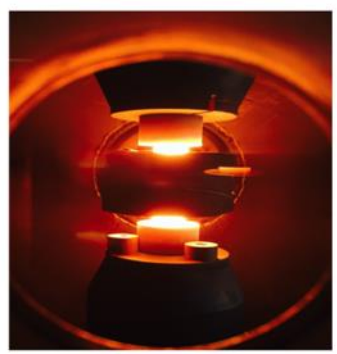
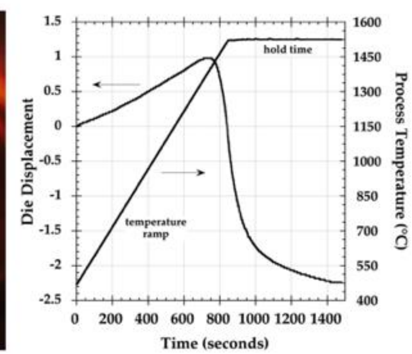
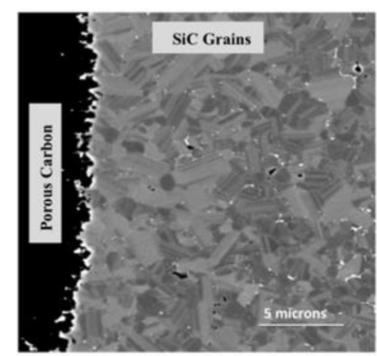
How **is your system transformational?**

- *AdMod Sys. 1 : Be 2nd Phase Materials*
- *AdMod Sys. 2 : ZrH 2nd Phase Materials*
- *Advanced moderator will allow more compact and safer core. Direct economic benefit from size and enhanced portability. Significant advantage gained if technology augments argument for reduced EPZ.*
- *Advanced manufacturing (i.e. Direct Current Sintering) is now allowing engineered structures (amalgams) of vastly different melting temperatures by "getting in under the kinetics."*

	Slowing Down Power $\zeta^*\Sigma_s$	T_{melt} (T_{decomp}) °C	Irradiate Perf, (~500°C, >20 dpa)	Therm. Cond. (650°C) W/m-K
Graphite	0.077	>(3000)	Poor	~20
CVD SiC	0.044	(2860)	Excellent	~80
ZrH	0.859	(>850)	unknown	~17
MgO	0.060	2853	Excellent	~50
Be_2C	0.125	(~2100)	unknown	~22
$ZrBe_{13}$	0.129	1525	unknown	~40
$TiBe_{12}$	0.138	1925	unknown	
BeO	0.124	2507	V.Bad, anisotropic	~30
Be	0.16	1287	Bad	~60







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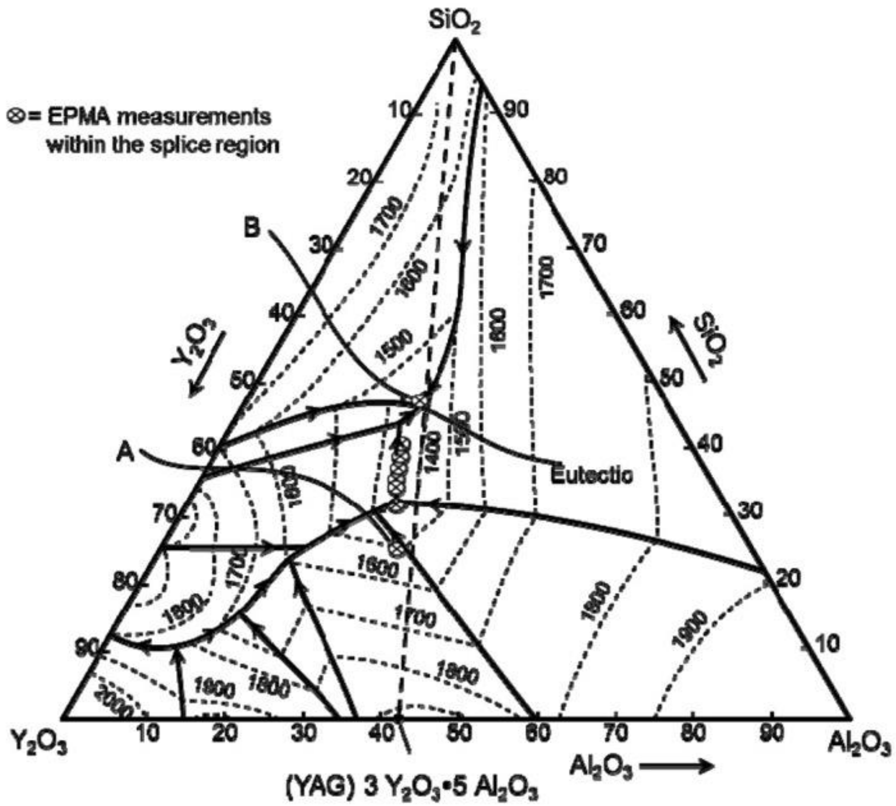

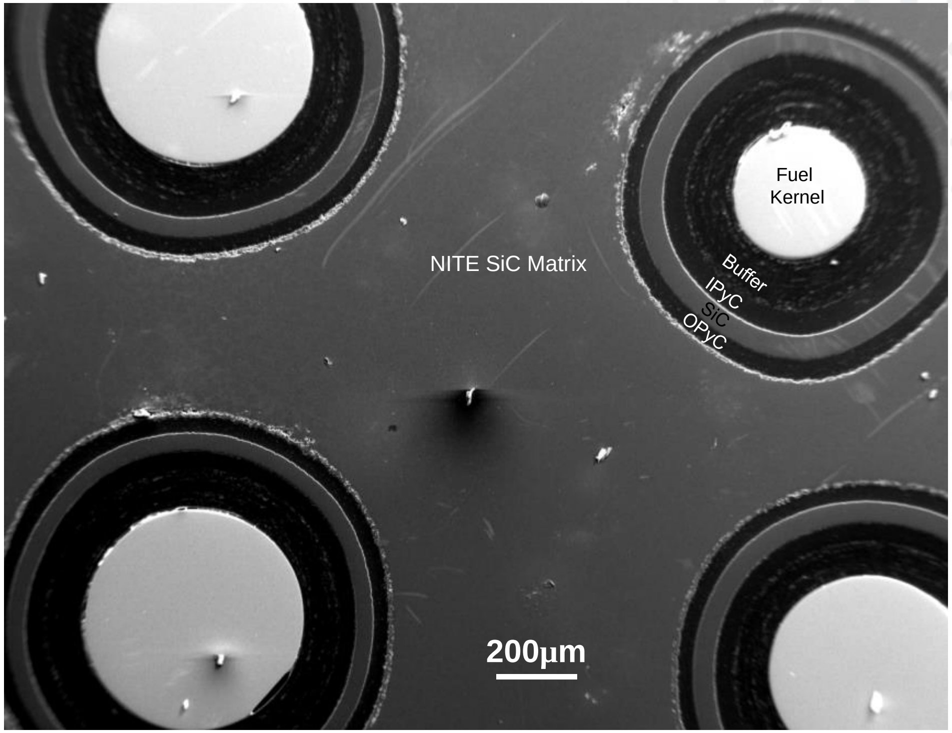

The MEITNER team applied an advanced manufacturing approach to patent the fundamental methods and mass production of FCM fuel.
The team will apply a similar approach to AdMod.

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What challenges **do you anticipate?**

- *Ad-Mod System 1: ZrH*
  - Loading and Control of ZrH
  - Loss of H at Temperature/Irradiation
  - Ability to and Stability of Cladding

- *Ad-Mod System 2: Be-based systems*
  - Suppressing matrix sintering temp.
  - Entraining toxic material
  - Thermal stability

- *Robust and viable materials systems*
  - Viable neutronics and safe reactor core
  - Economics from fabrication to system

- *TEA*