Decreasing Shock Sensitivity by containing Nitramin Particles with FOX-7 or FOX-12

Peter Gerber*, Thomas Heintz, Horst Krause
Fraunhofer Institut für Chemische Technologie

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* Contact: Peter.Gerber@ict.fraunhofer.de

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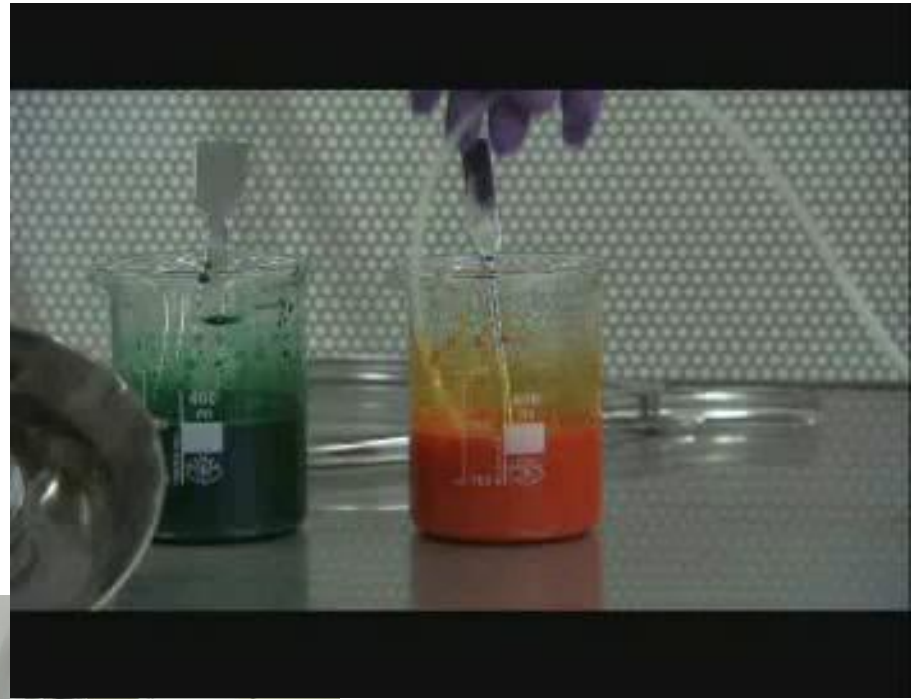
Outline

- Motivation / Goals
- Fluidized Bed technology
- Particle Characterization
- Formulation of cast able explosives
- Gap – Test results
- Conclusion
- Future work

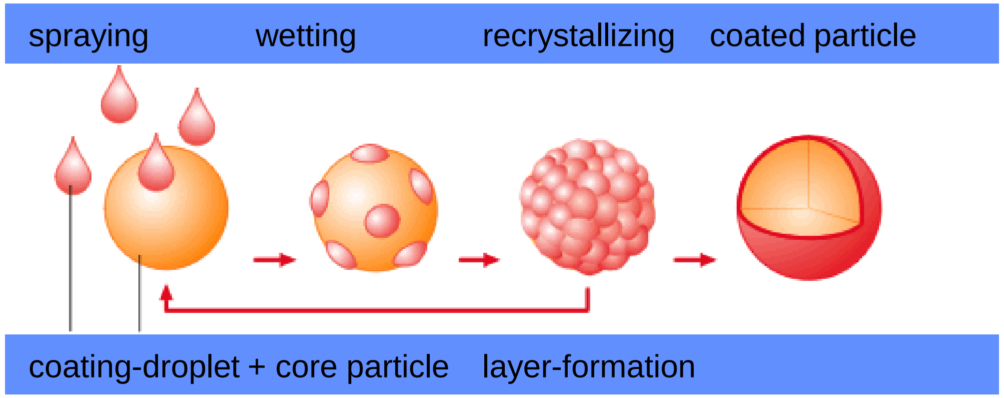
Particle-Coating: Fluidized bed technology

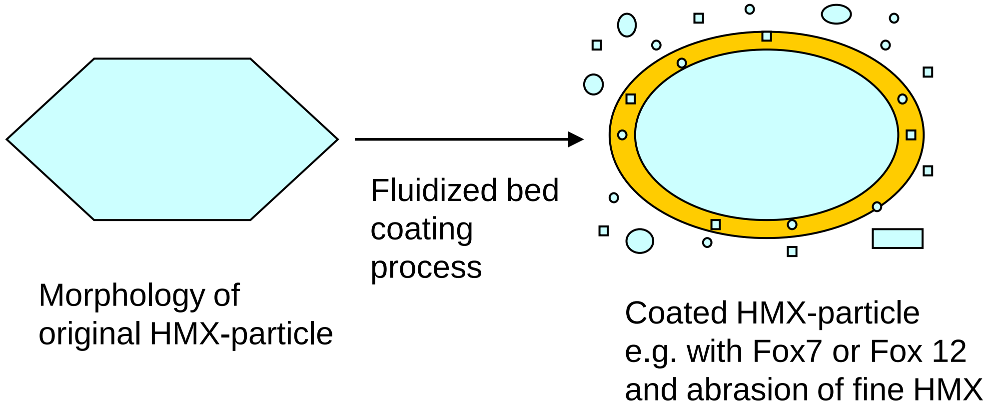
- Fluidized bed equipment:
- Type Mycrolab (Hüttlin GmbH) ➔ Lab-scale
- Type HKC 5 (Hüttlin GmbH) ➔ Field-scale
- Processing conception:
- Modification suitable for processing oxidizers and explosives



Creation of composite particles consisting of HMX/Fox7 or HMX/Fox12

- Intention: Cost effective standard materials (e.g. HMX) as core (90%) + special and high pricing materials (e.g. Fox7 or Fox12) at the surface (10%).
- Production method: Fluidized bed technology
- ⇨ Particles with core/shell- or mixed structure

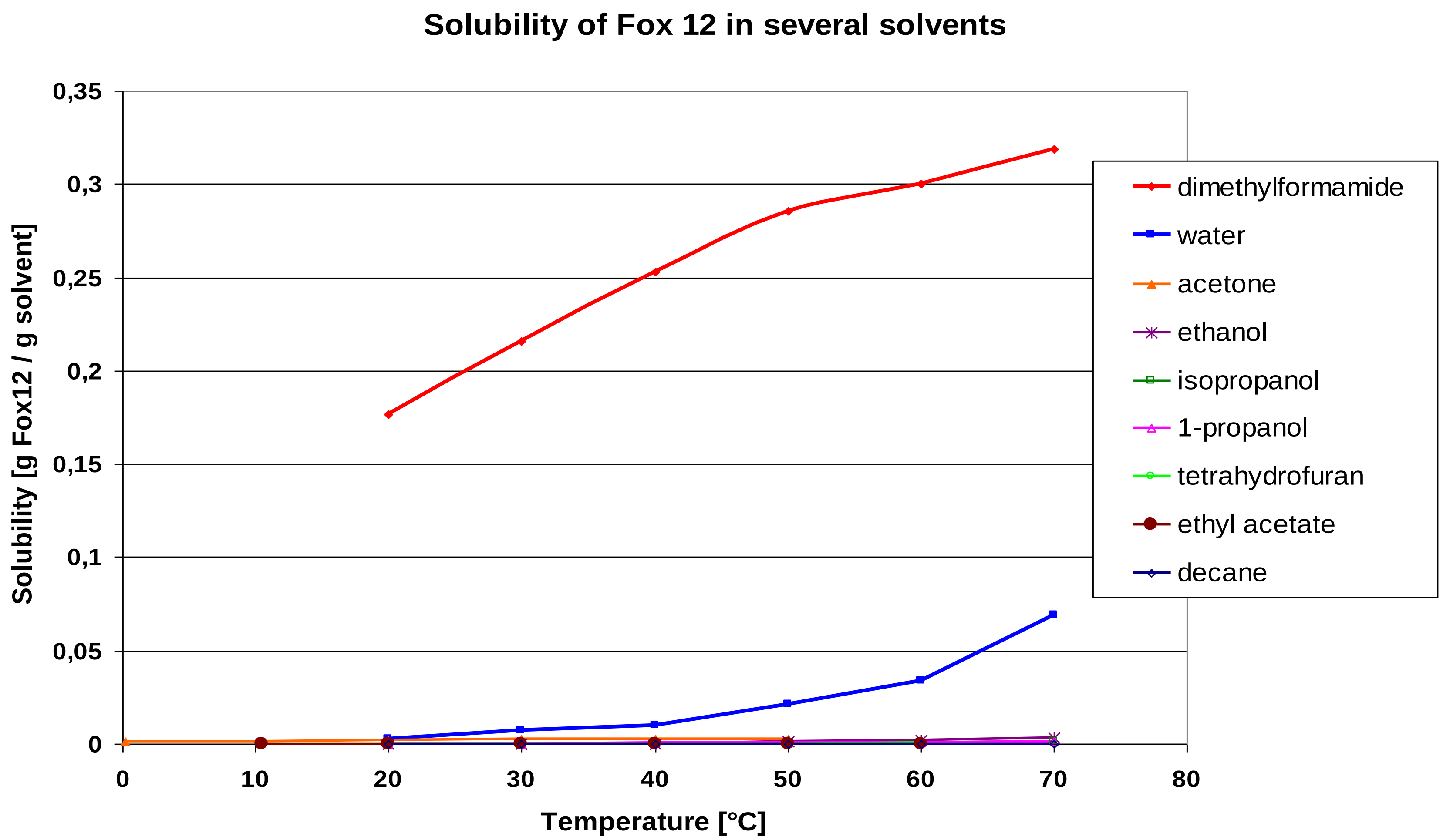




- Possible new applications:
  - Production of insensitive Nitramines, e.g. for high explosives.
  - Adding burn rate modifying substances to composite particles

Creation of composite particles consisting of HMX/Fox7 or HMX/Fox12

Requirement for fluidized bed technology: Coating material must be liquid resp. dissolved



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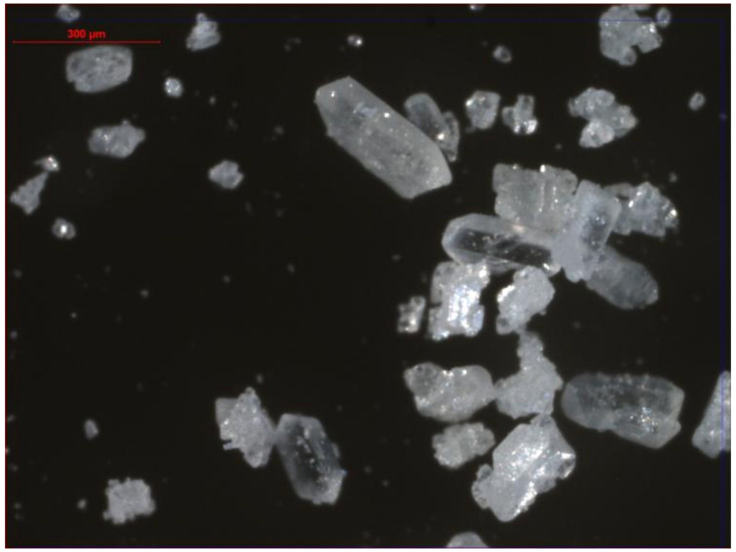
Composite particles consisting of HMX/Fox12

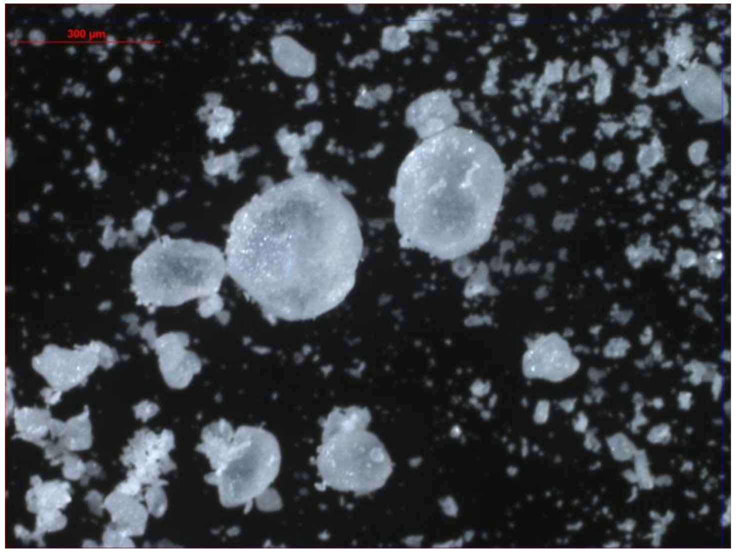
300 µm



HMX original:

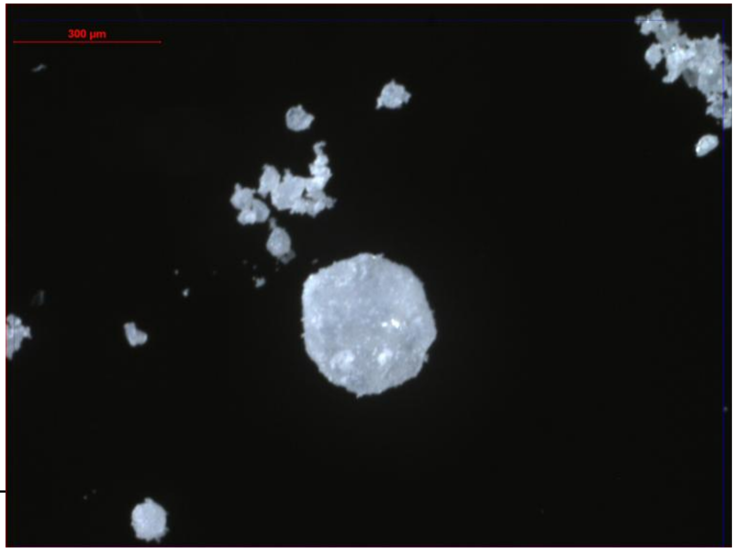
Typ B Class 1
DDP04D0049E

300 µm



HMX with 5 % Fox12

300 µm



HMX with 10 % Fox12

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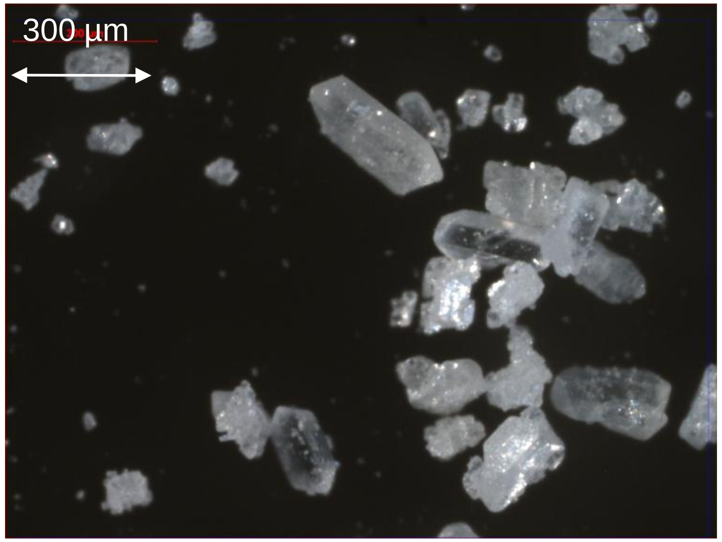
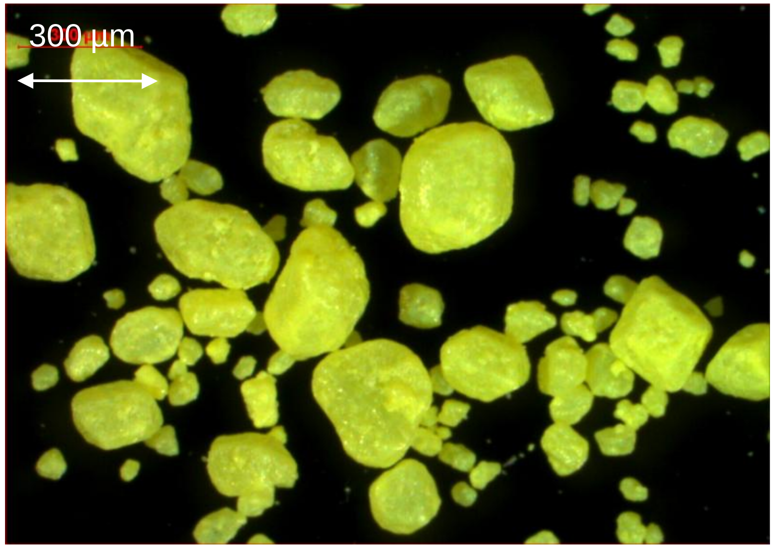
Composite particles consisting of HMX/Fox7 and GAP

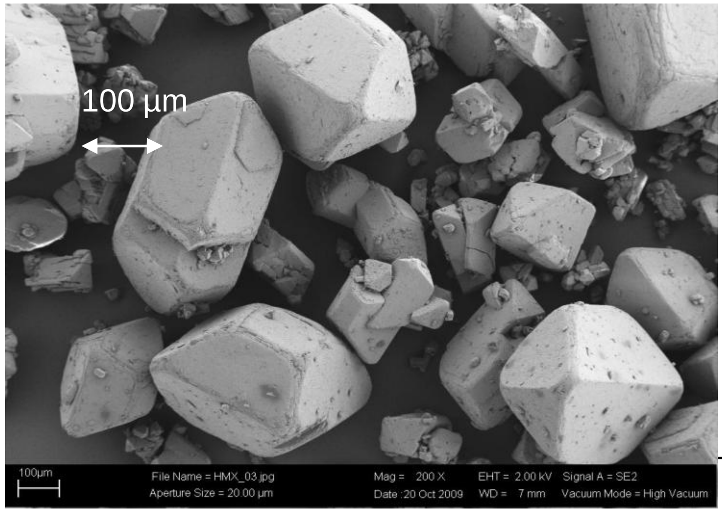


Light microscopy

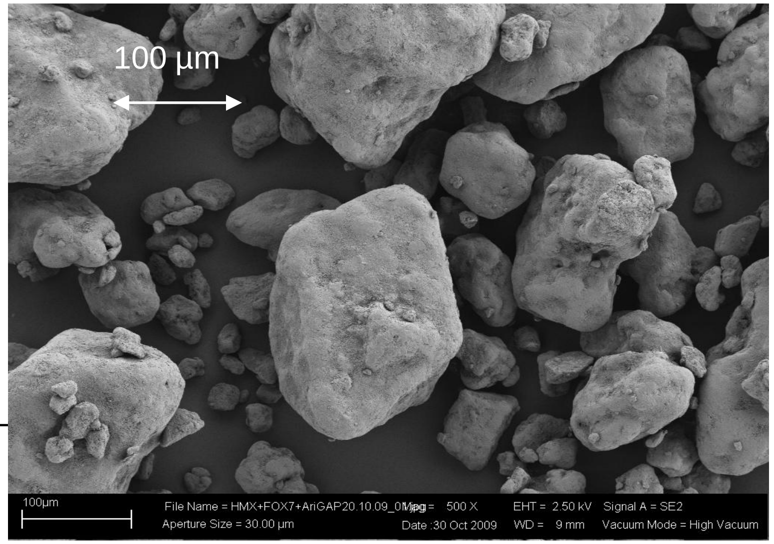


HMX original:Typ B

HMX with Fox7 / GAP



SEM



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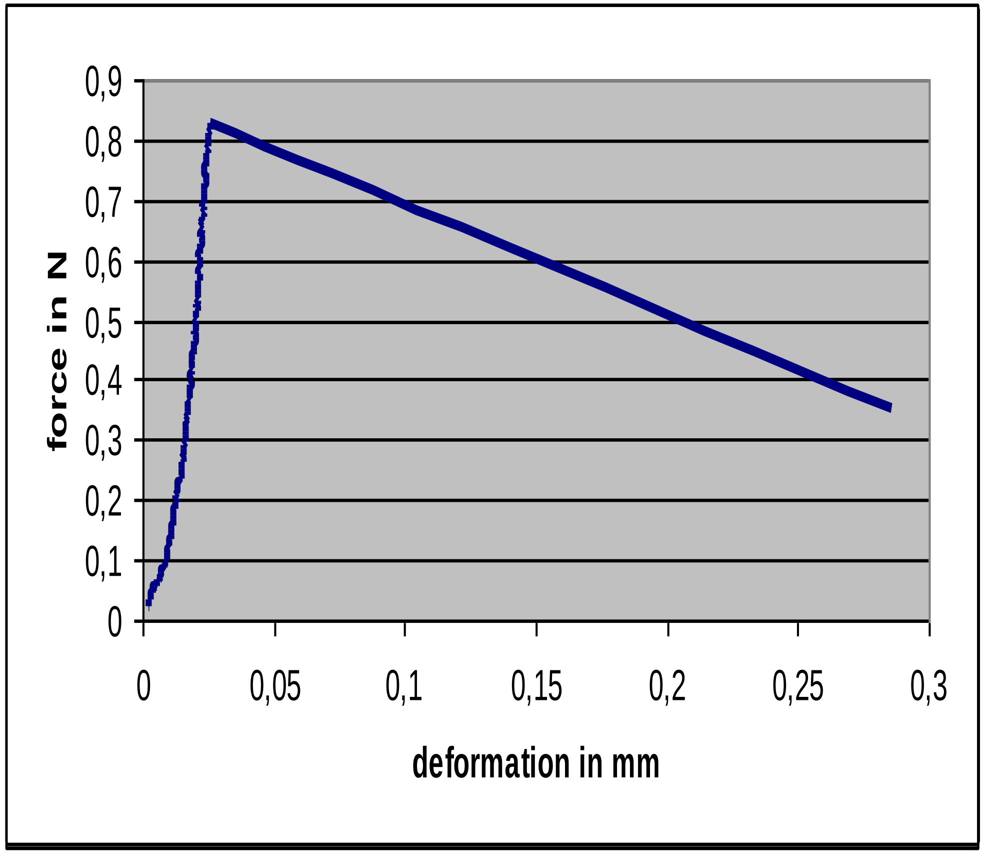
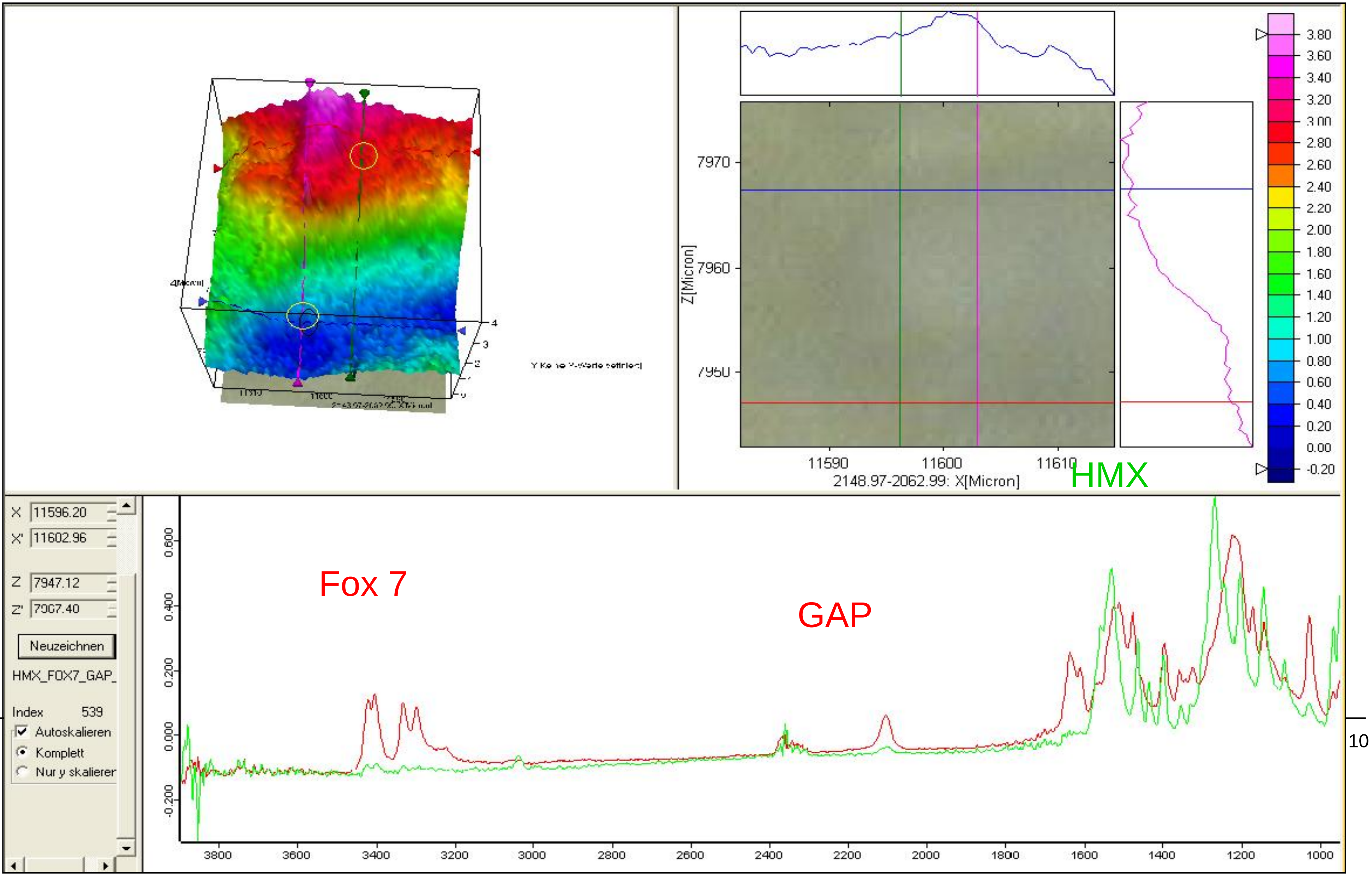
Characterization of composite particles (overview)

Sample	Mean particle size [µm]	Impact sensitivity [Nm]	Friction senitivity [N]	Particle crushing strength [N/mm2]
HMX core material: Typ B Class 1 DDP04D0049E	197	10	128	4,2
Fox 12	-	40	> 360	-
Fox 7	-	15	252	-
HMX + 10 % Fox 12	75 (abrasion)	7,5	160	not measurable
HMX + 10 % Fox 7	33 (abrasion)	15	324	not measurable
HMX pure, after 3 h fluidized bed process	56 (abrasion)	15	120	not measurable
HMX + 10 % Fox 7 + 5 % GAP	179	10	240	8,3

Particle crushing strength test (GFP) – example: HMX/Fox7/GAP composite



Characterization of composite particles (HMX/Fox7+GAP) with IR-spectroscopy (FTIR-Imaging)



Formulation work

PBX N – 109

84 %	Filler Content
	20 % Aluminium
	64 % Hexogen
16 %	HTPB Binder

PBX N – 109 analogue formulation

84 %	Filler Content
	20 % Aluminium
	64 % Nitramin => 10 % Coating
	90 % Nitramin
16 %	HTPB Binder

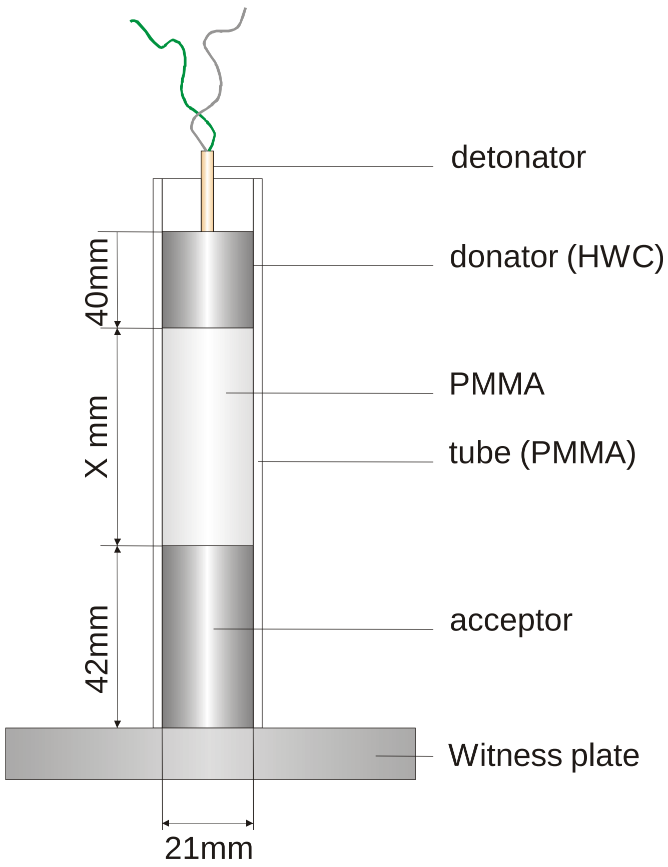
Studied Formulation

HXA	Energetic Filler	Coating
259	HMX, Type B	-
257	HMX, Type B	FOX-12
258	HMX, Type B	FOX-7
261	HMX, Type B	FOX-12 / GAP
262	HMX, Type B	FOX-7 / GAP
260	HMX, Type B	FOX-12 / GAP + CNT

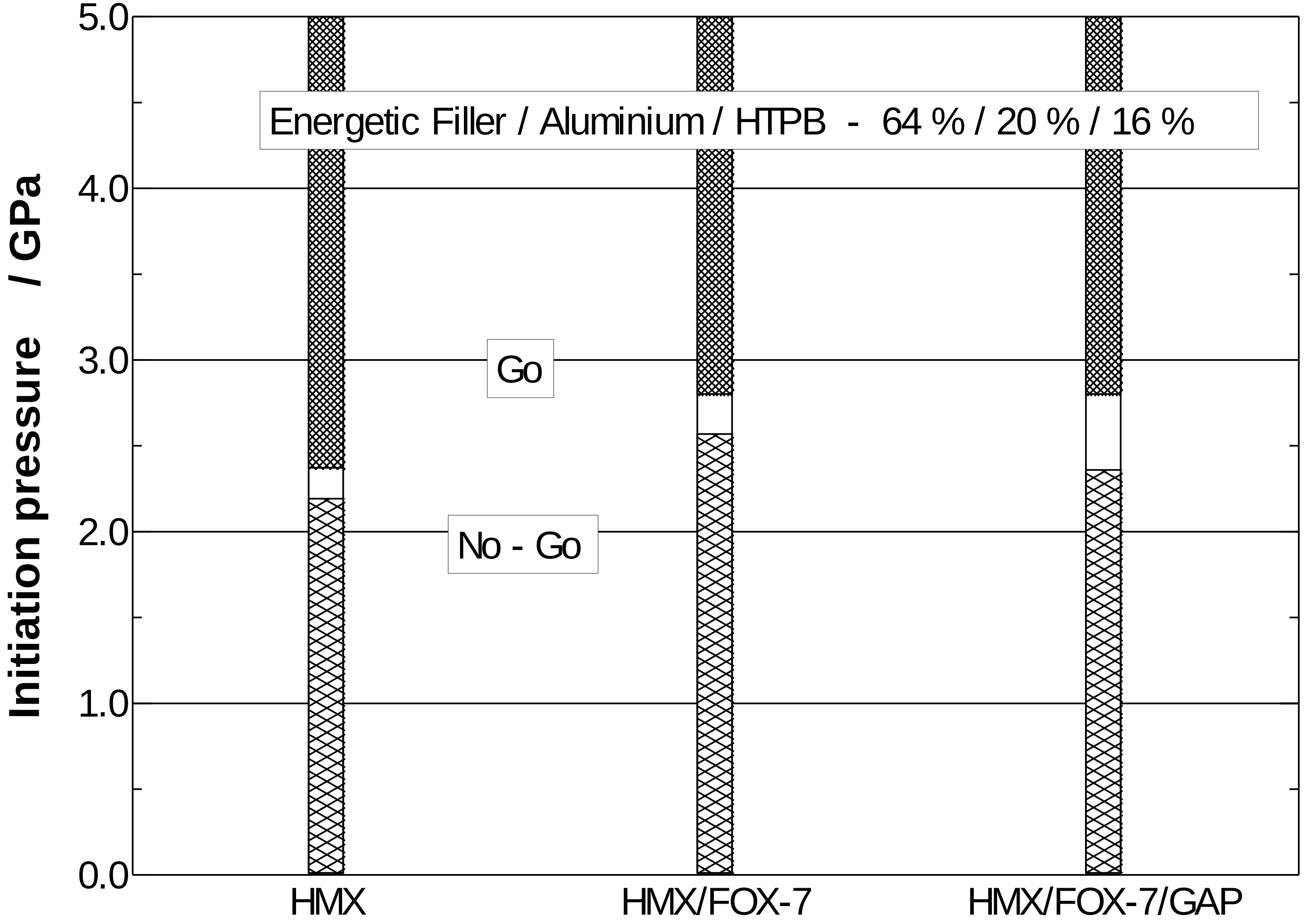
Impact and Friction Sensitivity

Formulation	Friction	Impact
HXA	N	Nm
259	360	20
257	360	20
258	360	20
261	360	20
262	360	20
260	360	20

Gap – Test   Ø 21 mm



21 mm PMMA - Gap Test results



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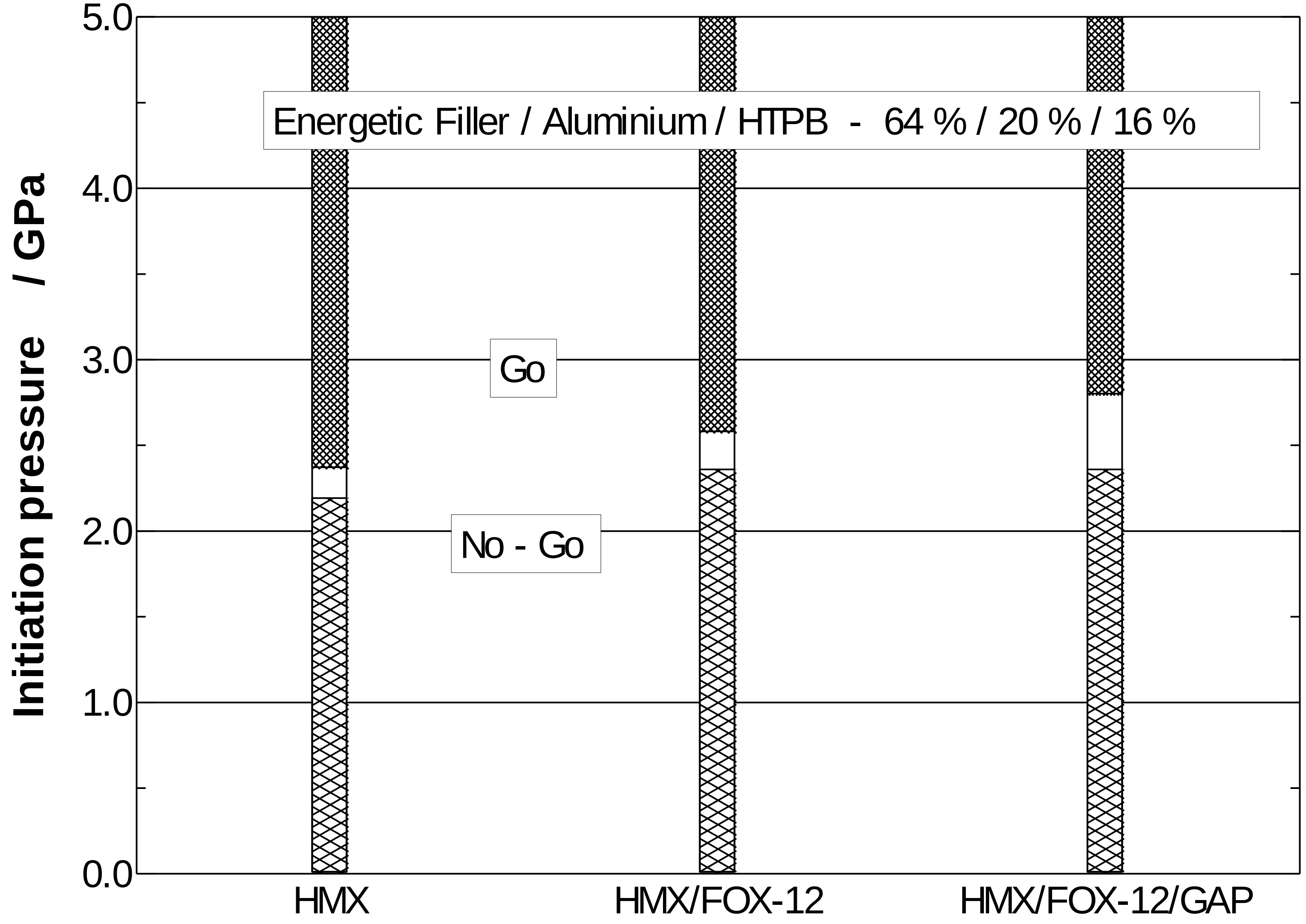
21 mm PMMA - Gap Test results



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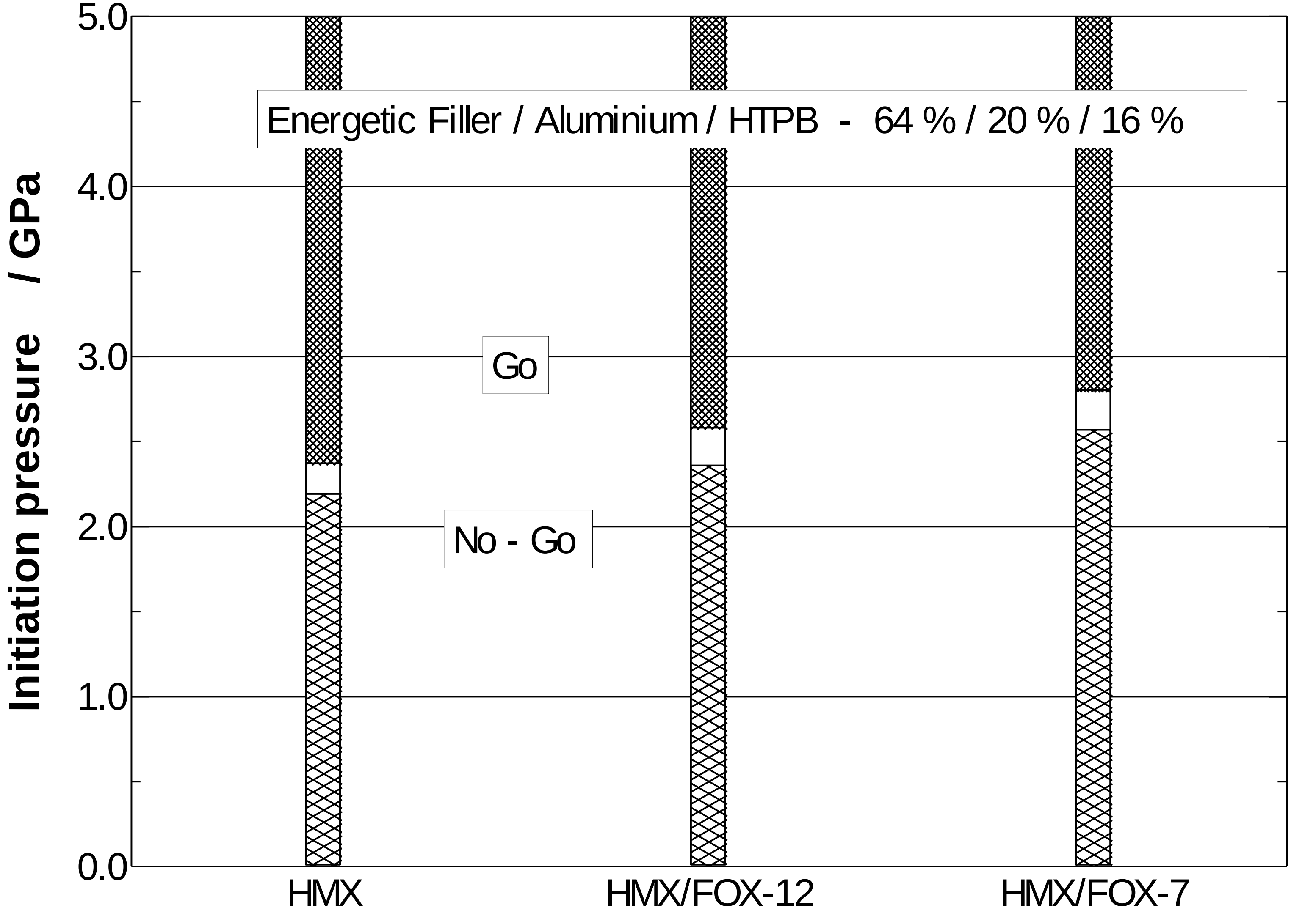

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Conclusion

- Fluidised bed technology is useful to produce coated energetic particle
- FOX-7 and FOX-12 are suitable coating materials to reduce the shock sensitivity

Future Work

- Gap Test with 50 mm , based on coated Octogen
- Transfer the results to Hexogen

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Thank You For Your Attention!