

INDAGINE SU ALCUNI POLIMERI E LA TENDENZA CHE HANNO A FORMARE SHEAR BAND AD ALTO STRAIN RATE

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XTREMA

- | | | | |
|---------------------------------------|------------------------------------|---|--------------|
| 1. PP (Polipropilene) | } <i>Temperatura e Strain rate</i> | } | Ductile |
| 2. PETP (Polietilene tereftalato) | | | |
| 3. PC (Policarbonato) | | | |
| 4. PMMA (Polimetilmetacrilato) | } <i>Temperatura e Strain rate</i> | } | Semi-ductile |
| 5. Resina epossidica commerciale DLP | | | |
| 6. PEI/CNT (Polyetherimide) FFF ≡ FDM | | | |
| 7. Carbon-PA (Poliammide) FFF ≡ FDM | | | |
| | | } | Brittle |
| | | | |



TERMOPLASTICI

Denominazione tecnica	Sigla	Denominazione commerciale	Classe	Applicazioni	Tecnologia
Polipropilene	PP	Profax ecc	Semi-crystalline Polymers	Geometrie complesse	Iniezione
Polietilene tereftalato	PETP	Arnite	Semi-crystalline Polymers	Apparecchiature industriali e farmaceutiche; Barra di Hopkinson	Varie
Policarbonato	PC	Ultem ecc	Glassy Amorphous Polymers	Protezioni, valvole, Lenti dei fari automobilistici	Varie
Polimetilmetacrilato	PMMA	Plexiglass ecc	Glassy Amorphous Polymers	Lastre, tubi	Varie
Polyetherimide	PEI	Ultem	Glassy Amorphous Polymers	Comportamento ignifugo	Varie
Poliammide	PA	Nylon	Glassy Amorphous Polymers	Guarnizioni, contenitori, cuscinetti a strisciamento ecc	Iniezione

TERMOINDURENTI

Denominazione tecnica	Sigla	Denominazione commerciale	Applicazioni	Tecnologia
Resine epossidiche	EP	Epoxin ecc	Geometrie complesse, collanti	Stampaggio formatura

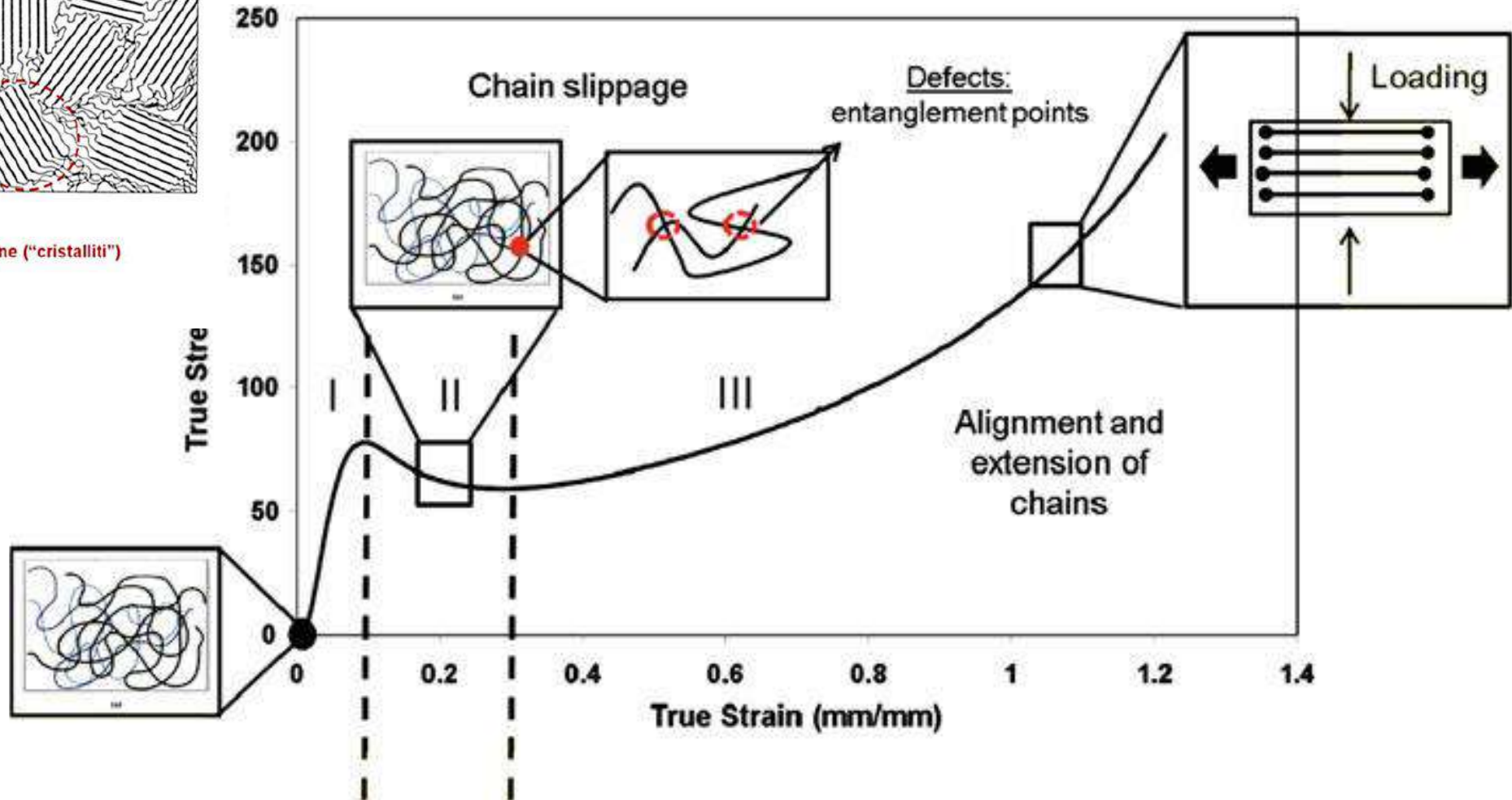
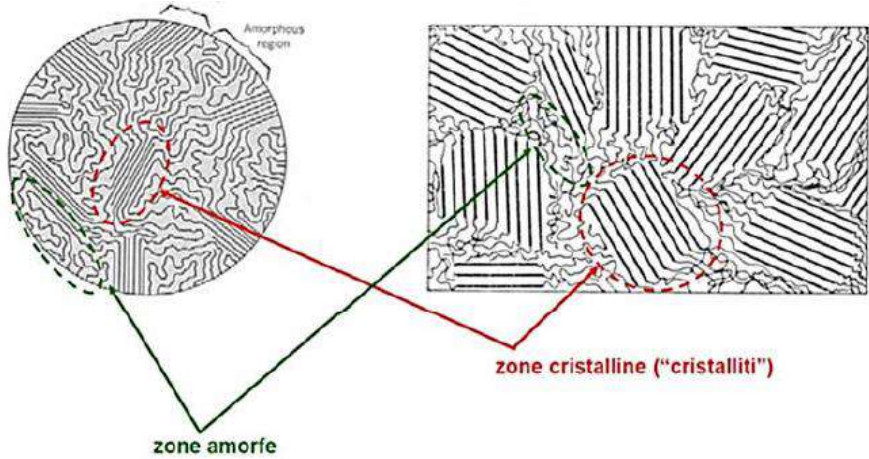


- Materiali polimerici sono ampiamente usati per il packaging, componenti medici, parti di autoveicoli, sistemi di protezione individuale etc., grazie ai vari processi produttivi cui possono essere sottoposti.
- Componenti realizzati con tali materiali, in servizio, possono essere soggetti a carichi dinamici, quali ad esempio quelli conseguenti ad urti, che ne causano deformazioni e fratture compromettendone la prestazione e la durata.
- E' fondamentale comprendere la capacità che questo tipo di materiali hanno di resistere a carichi dinamici intesa come risposta durante il processo di deformazione plastica e il danno che ne consegue ad alto strain rate.
- Tutto ciò risulta maggiormente importante se si pensa che a causa di un loro comportamento instabile durante la deformazione c'è il rischio di una loro imprevedibile catastrofica rottura.



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Introduzione



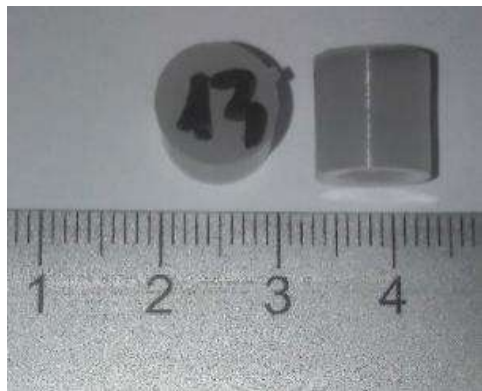


Oggetto

Discussione sul comportamento meccanico di alcune tipologie di polimeri e la tendenza nel concentrare la deformazione in narrow bands se deformati ad alto strain rate

I materiali testati ed analizzati sono sette polimeri

Alcuni di questi polimeri in condizioni di compressione dinamica e a specifiche temperature possono mostrare o no una concentrazione di deformazione plastica in shear bands



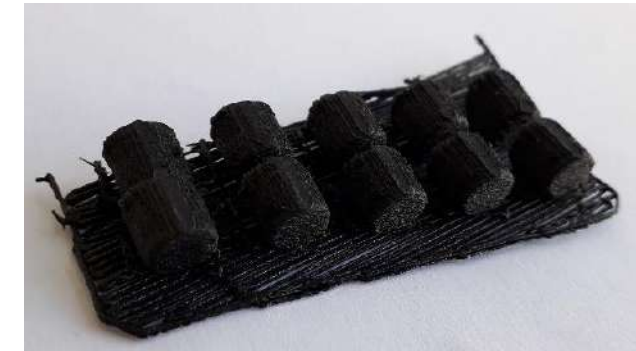
PP



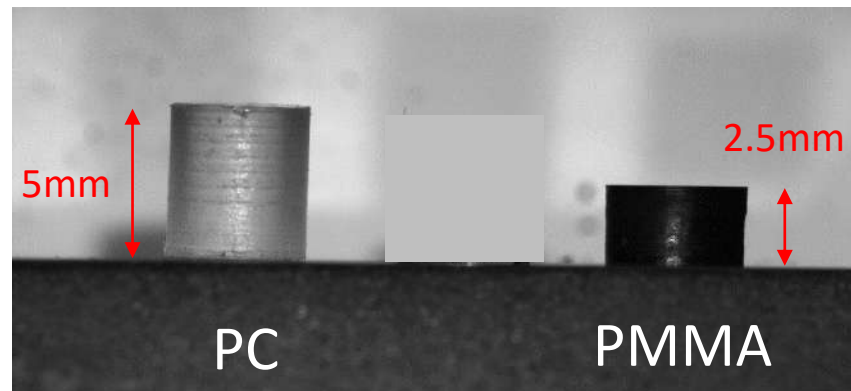
PETP



Resina epossidica

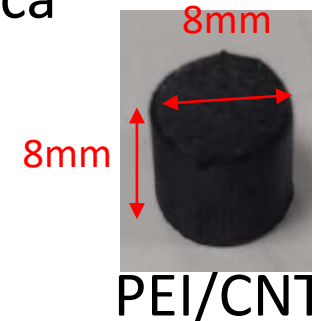


Carbon-PA



PC

PMMA

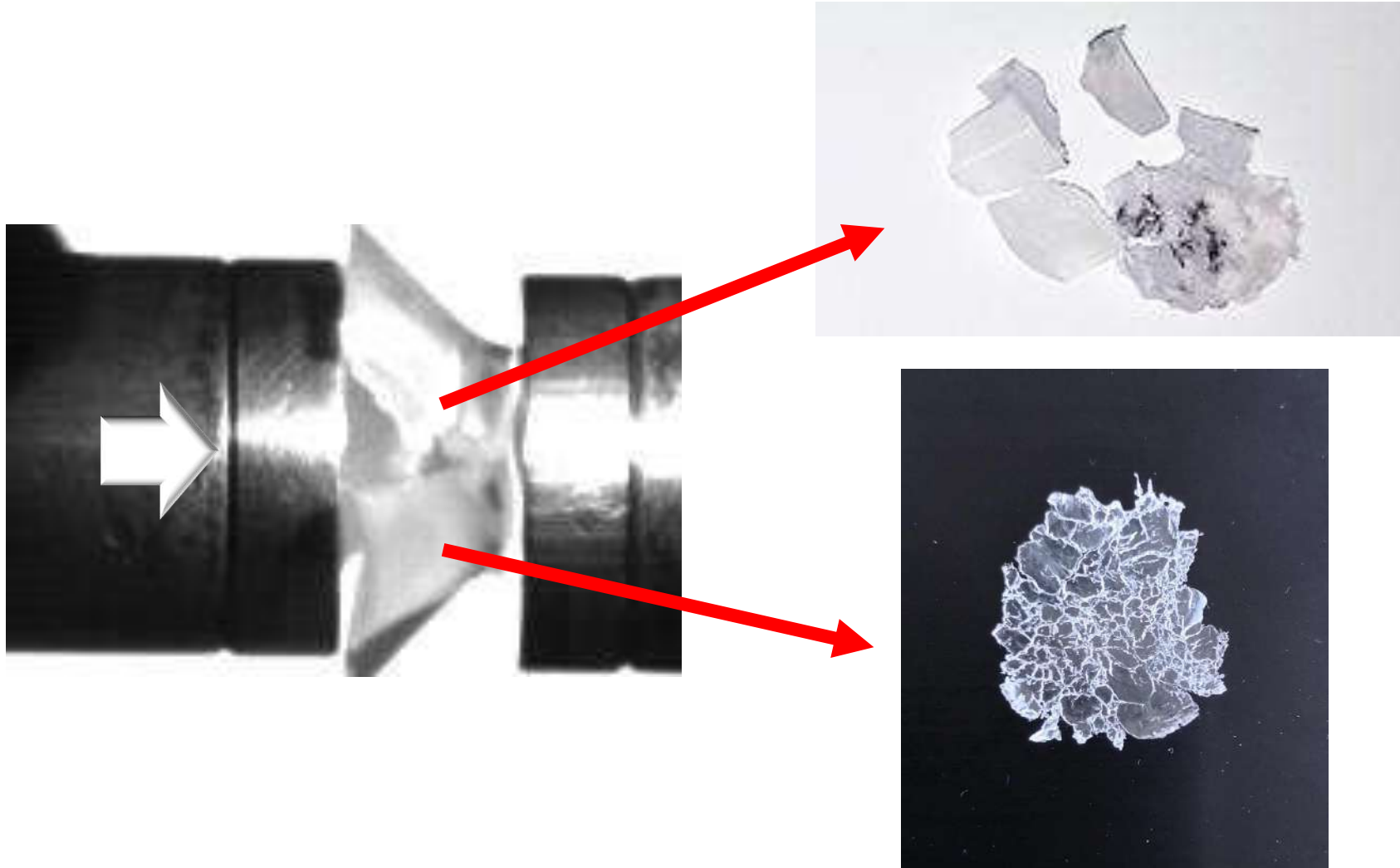


PEI/CNT



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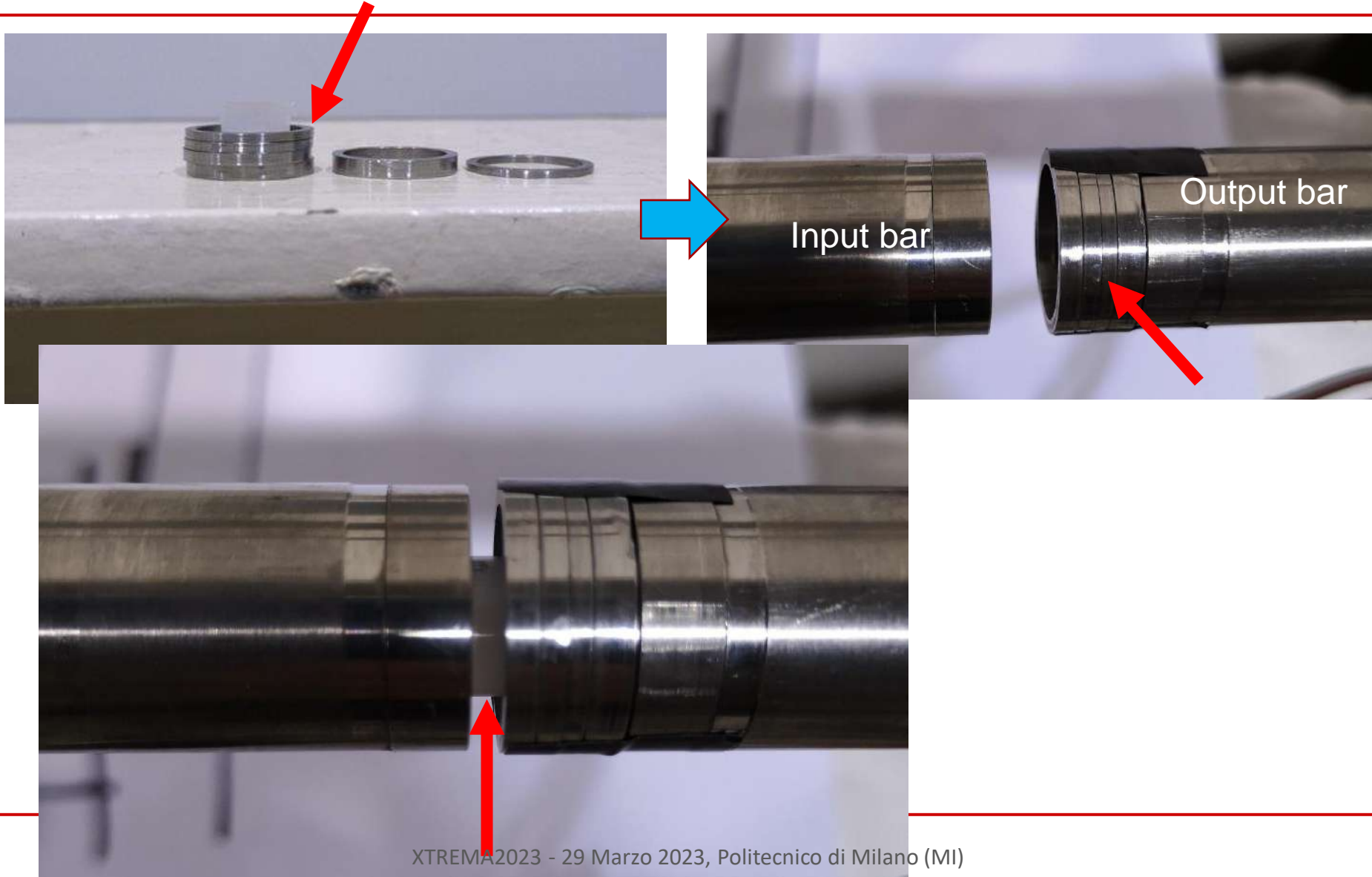
Polipropilene PP

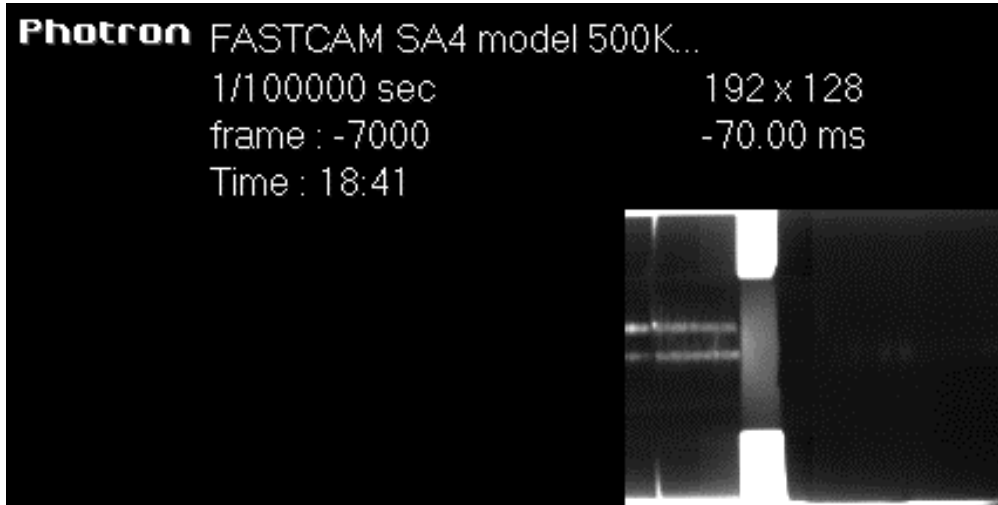
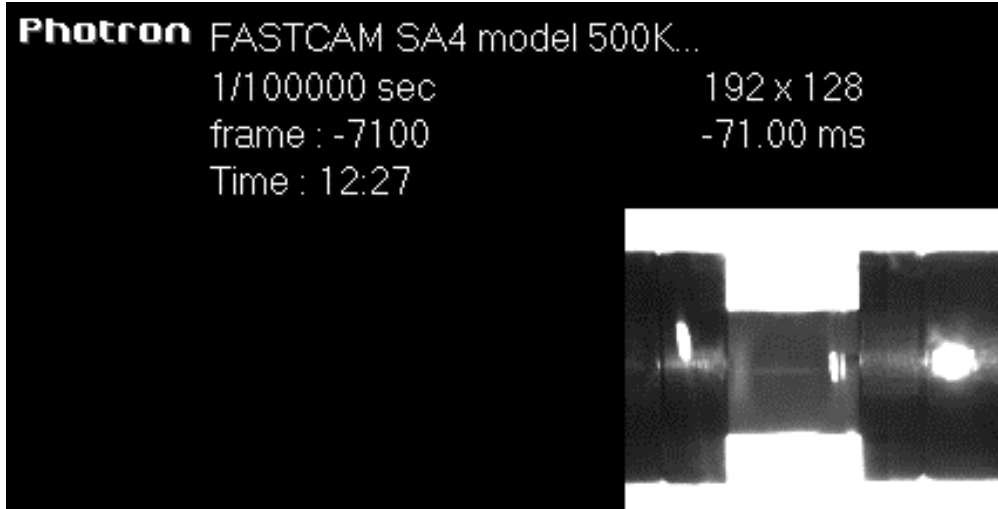




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Polipropilene

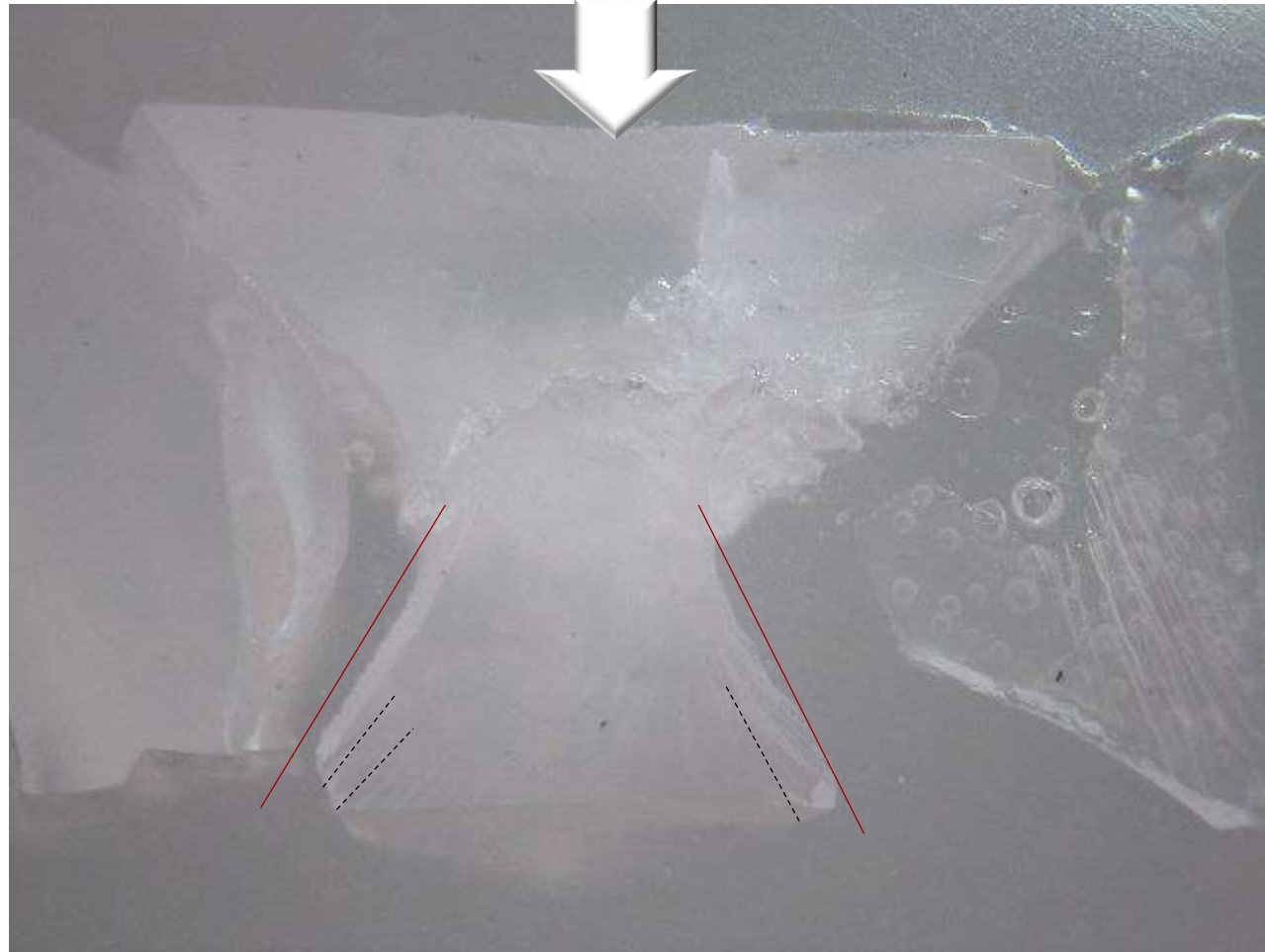




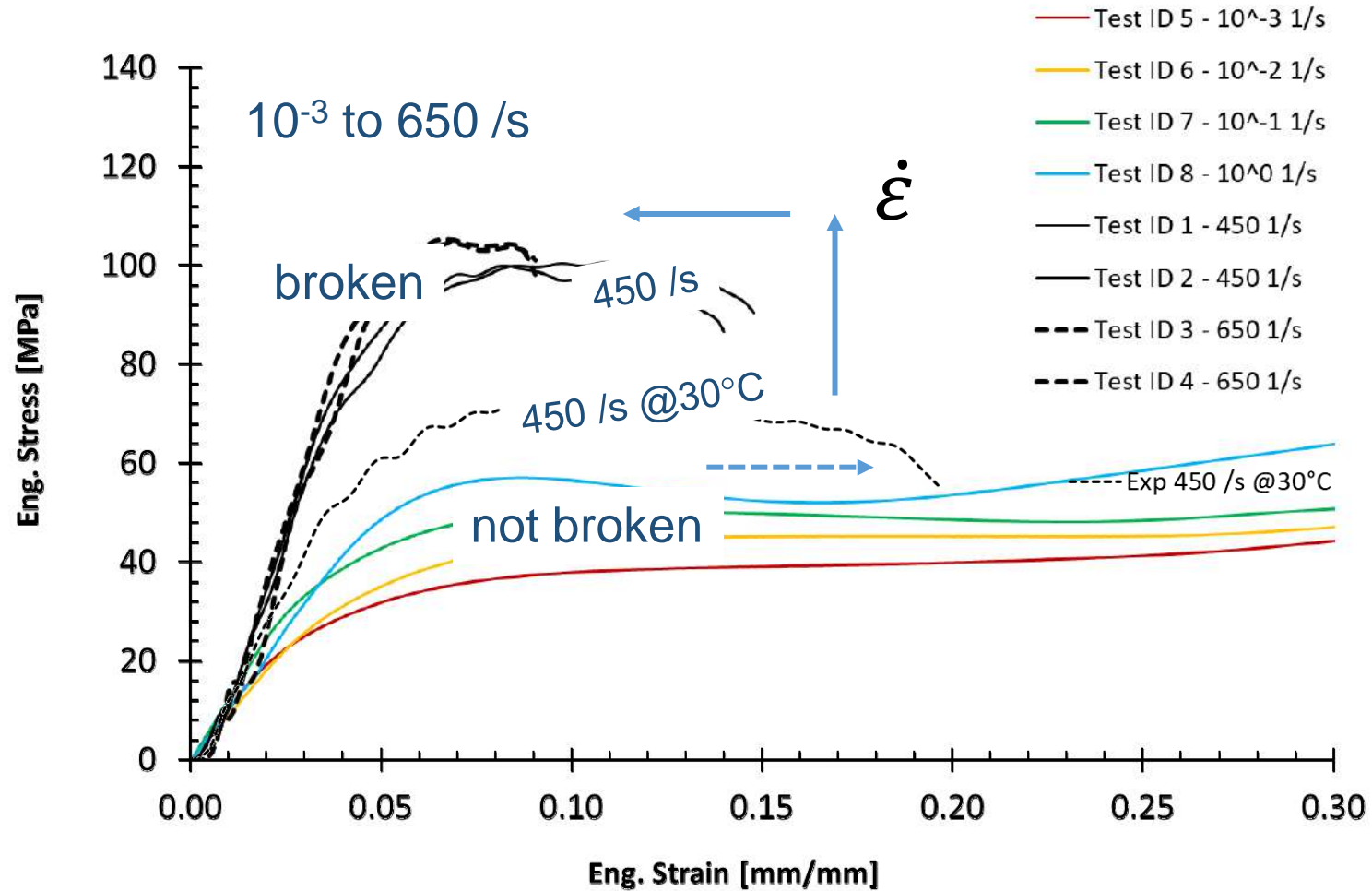


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Polipropilene



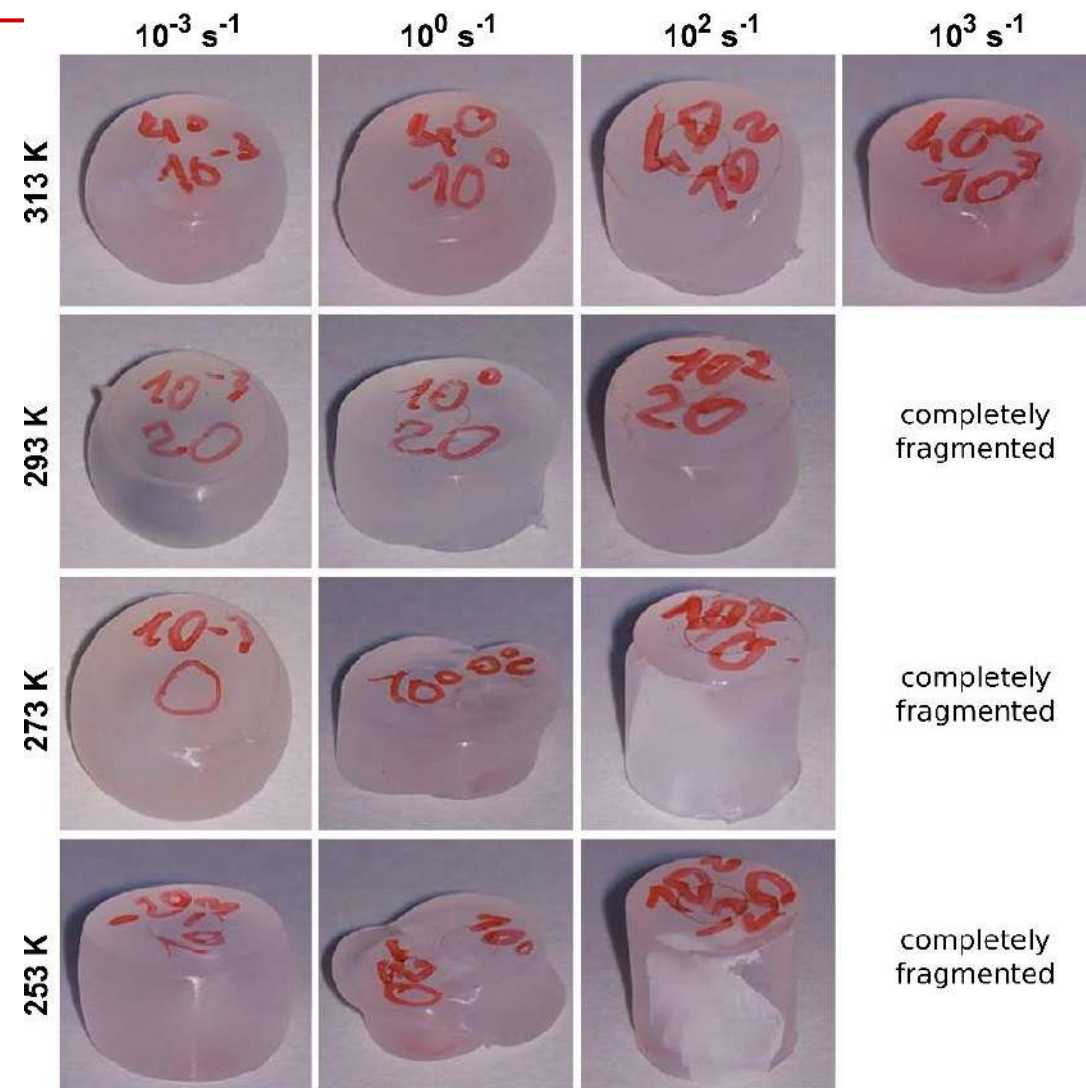
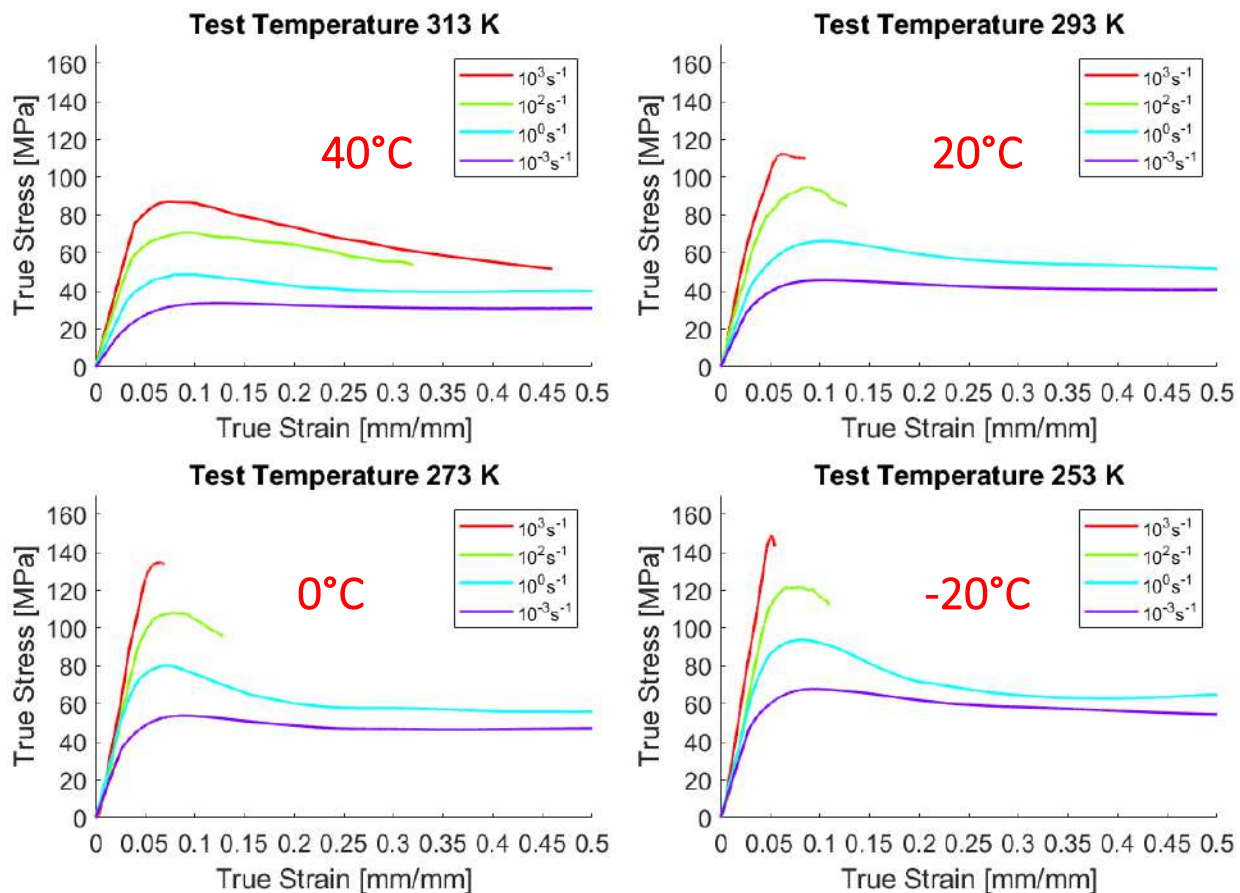
Adiabatic shear conical cones





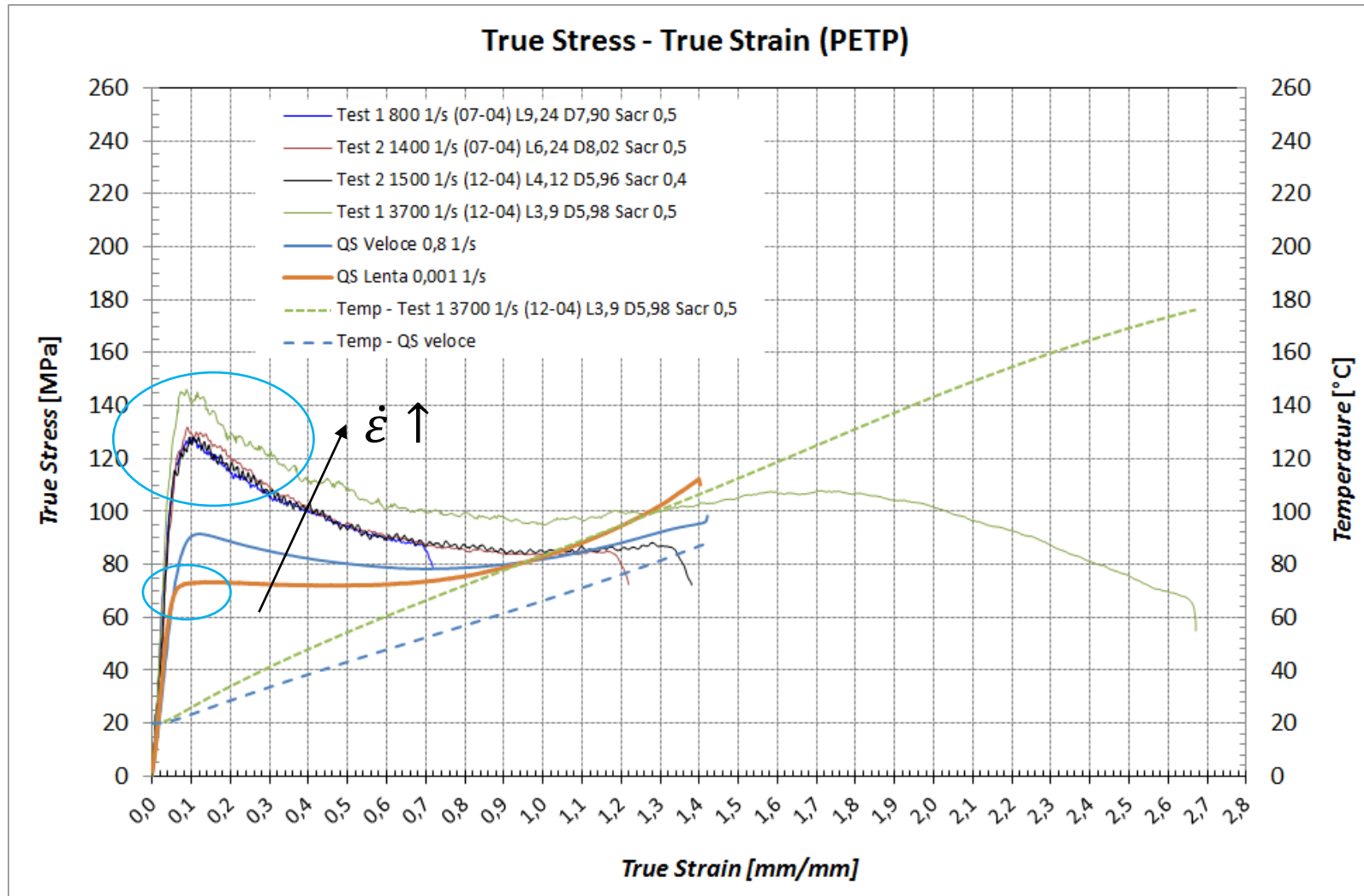
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Polipropilene



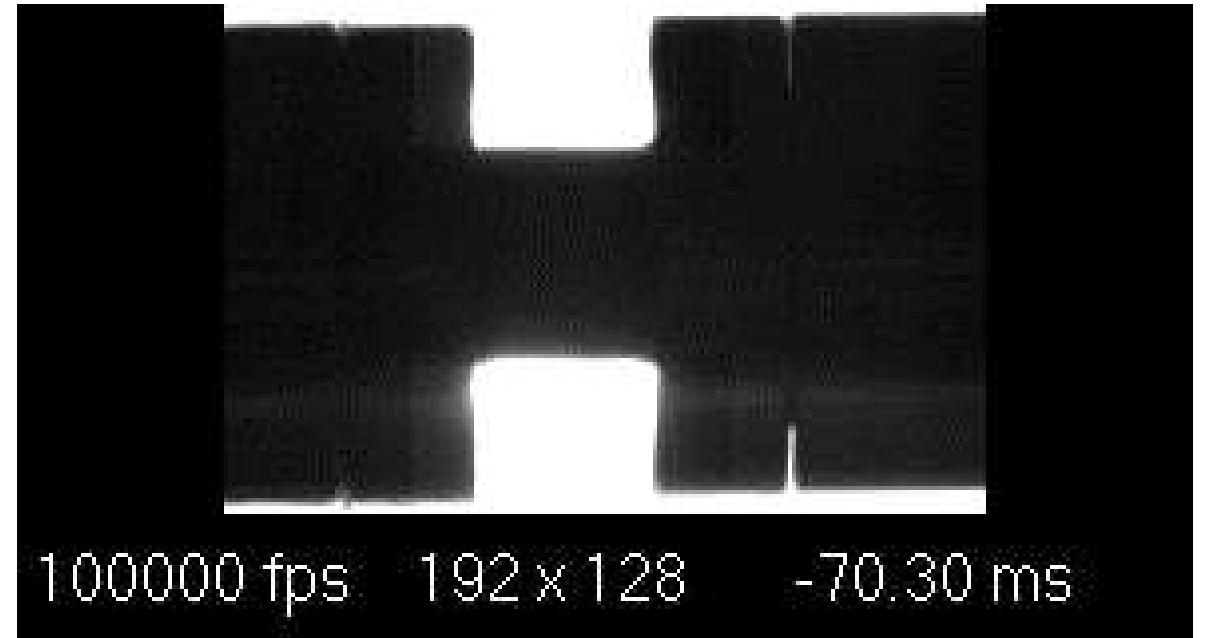
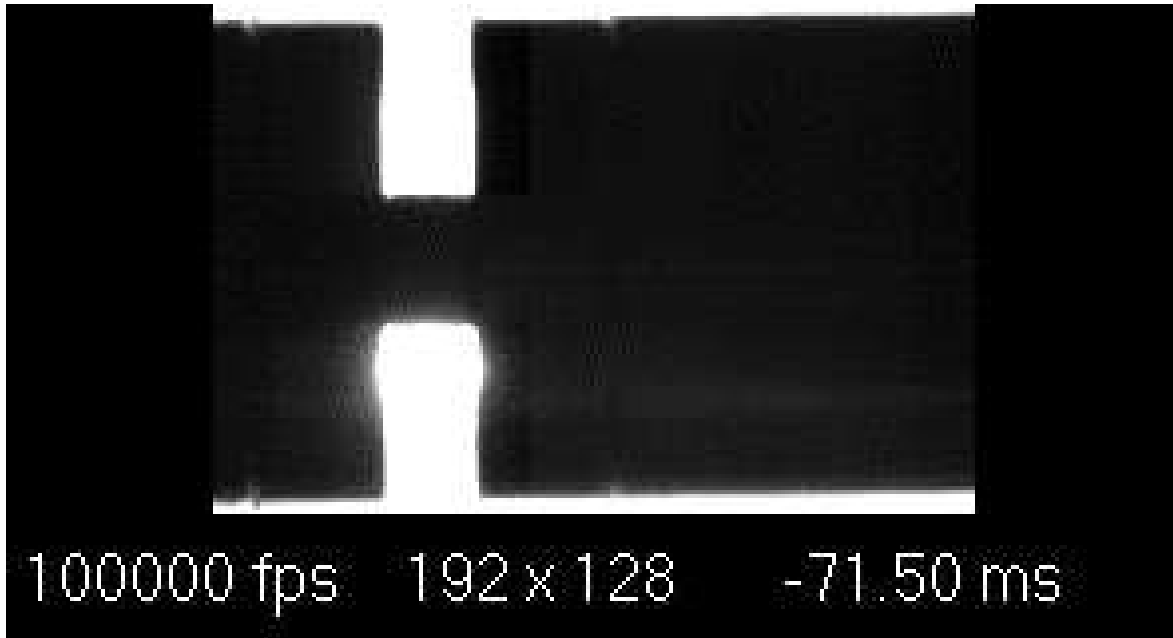


XTREMA Polietilene tereftalato PETP (Arnite)



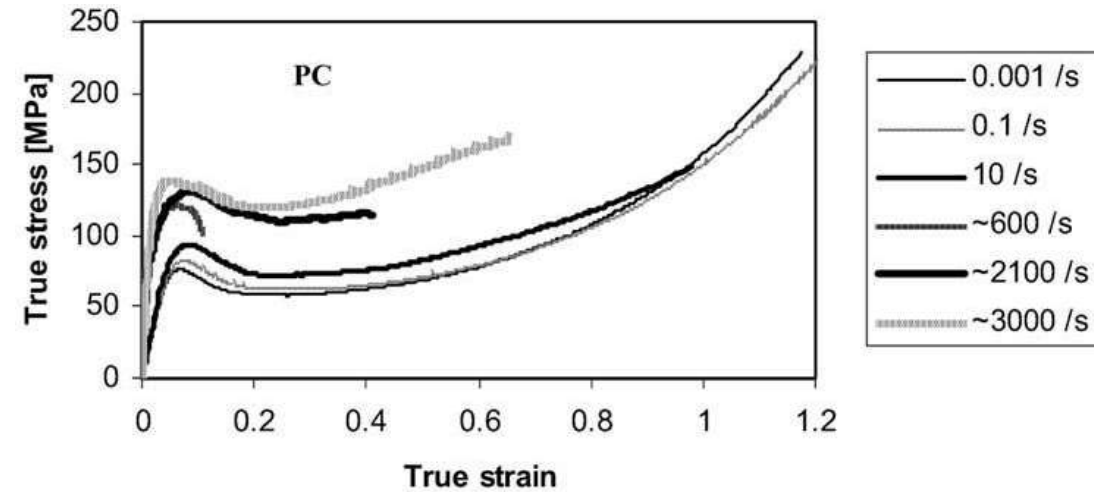
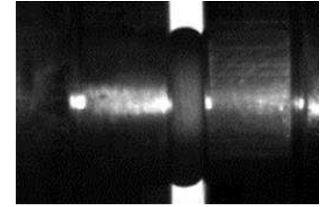
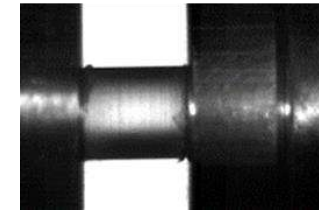
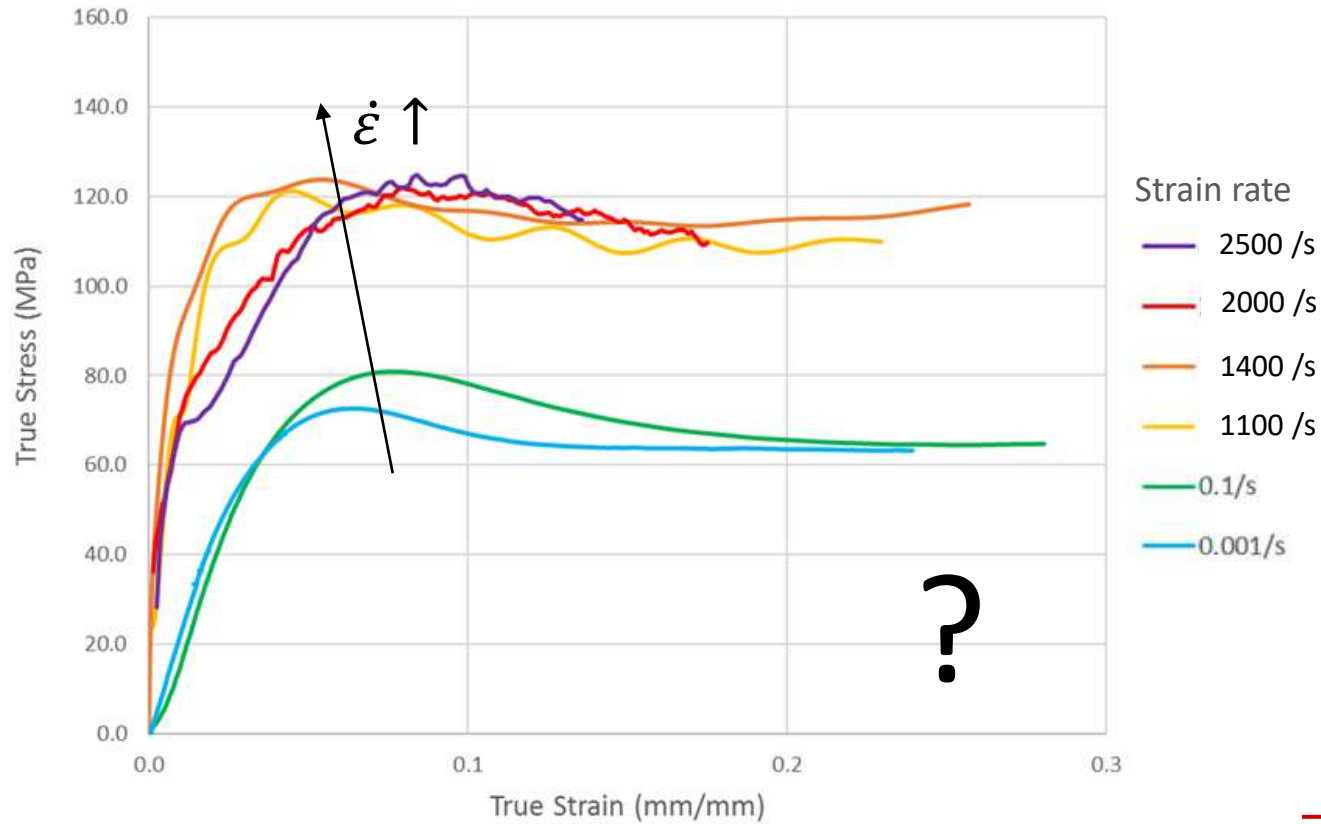


XTREMA Polietilene tereftalato PETP (Arnite)





True Stress-Strain PC





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Policarbonato (PC)



Photron FASTCAM SA4 model 500K...

1/100000 sec

frame : -7060

Time : 15:42

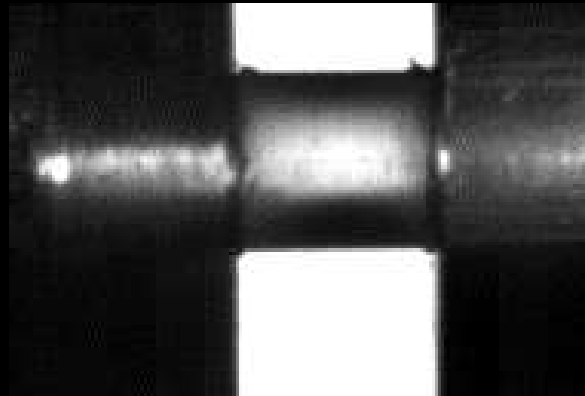
192 x 128

-70.60 ms

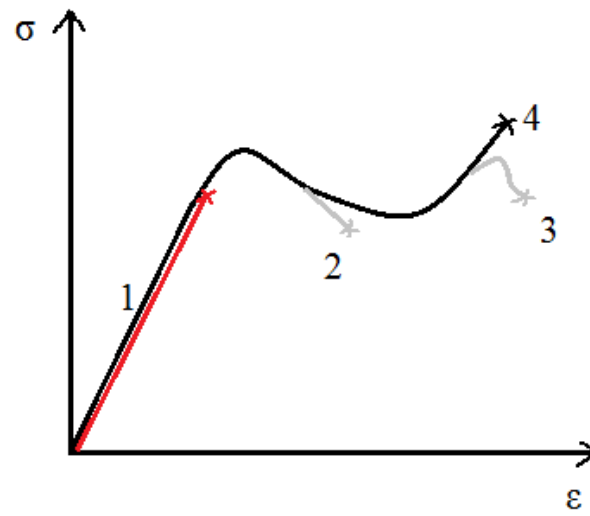
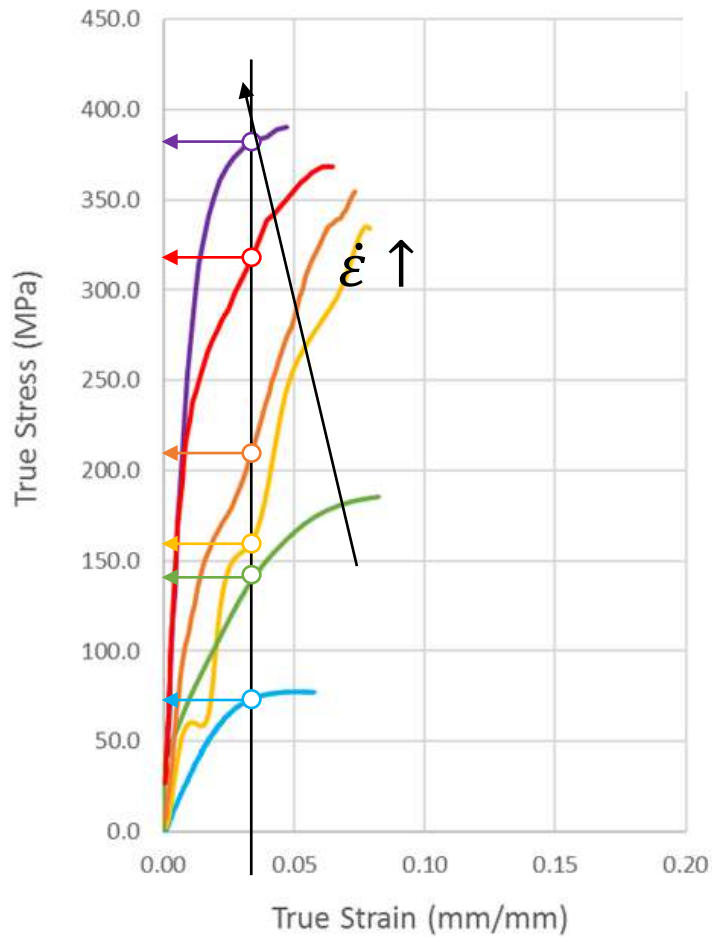
100000 fps

Center

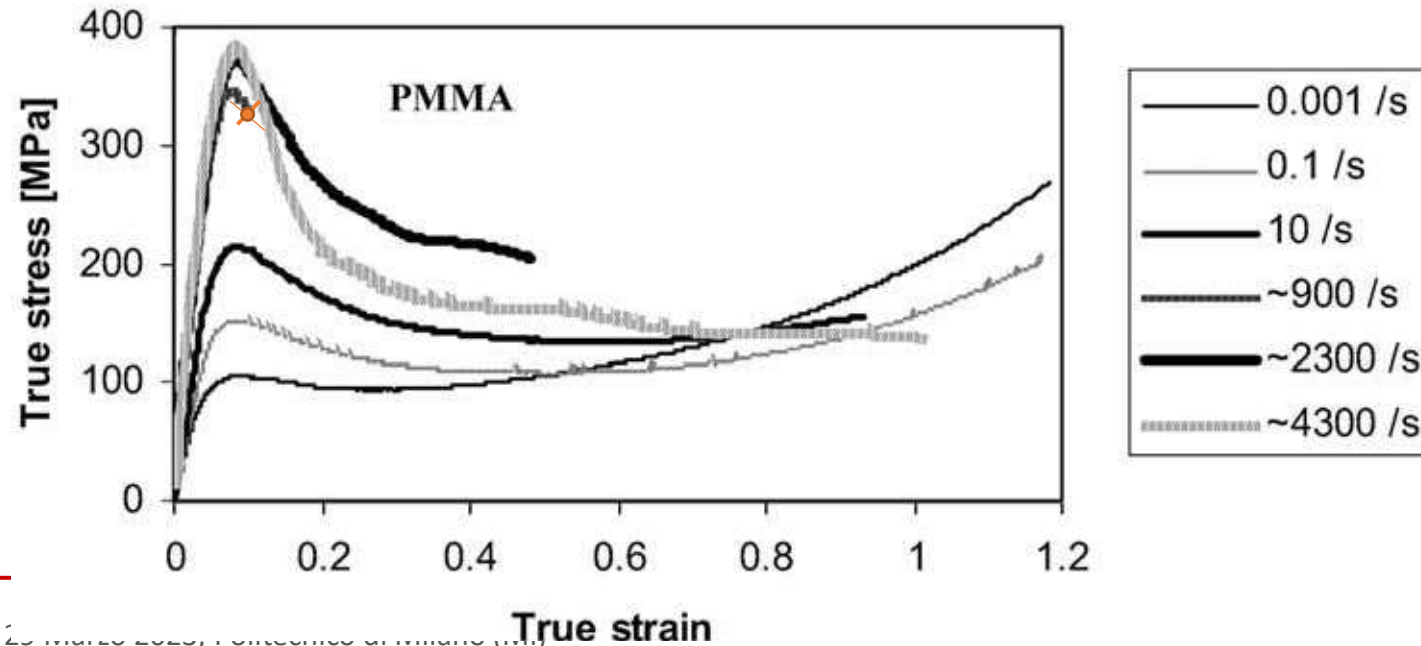
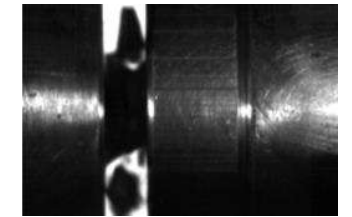
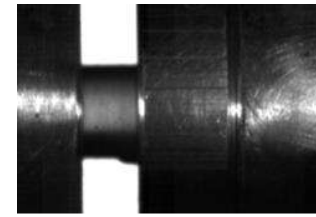
Date : 2018/1/18



True Stress-Strain PMM



MA)





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Polimetilmetacrilato (PMMA)



Photron FASTCAM SA4 model 500K..

1/100000 sec

frame : -6830

Time : 13:33

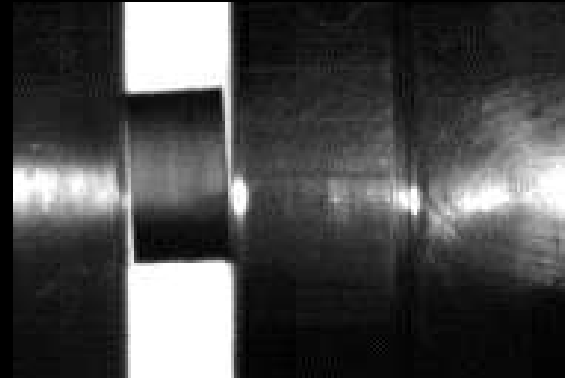
192 x 128

-68.30 ms

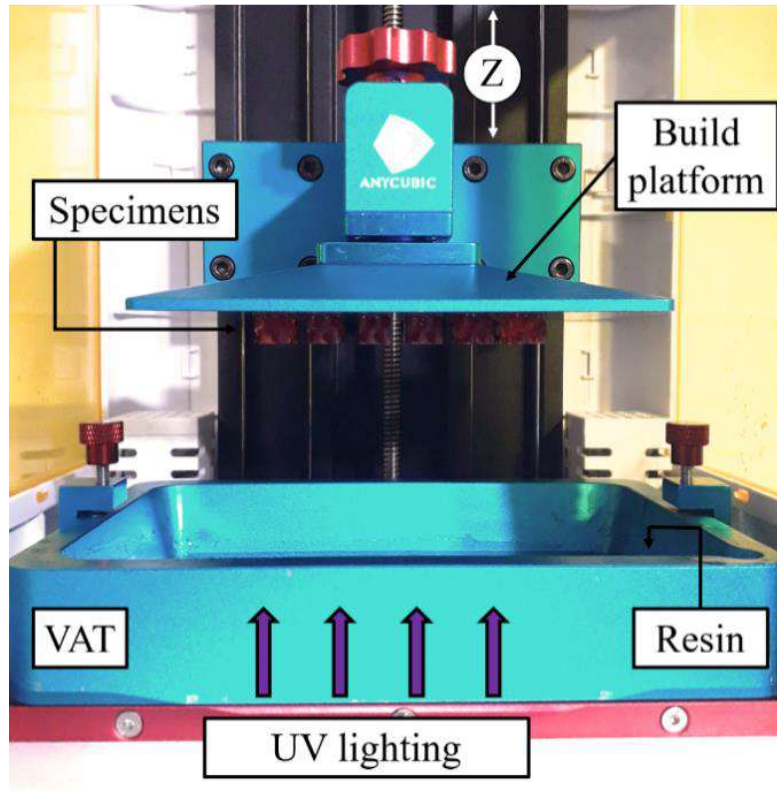
100000 fps

Center

Date : 2018/1/18



- Anycubic Photon S 3D printer



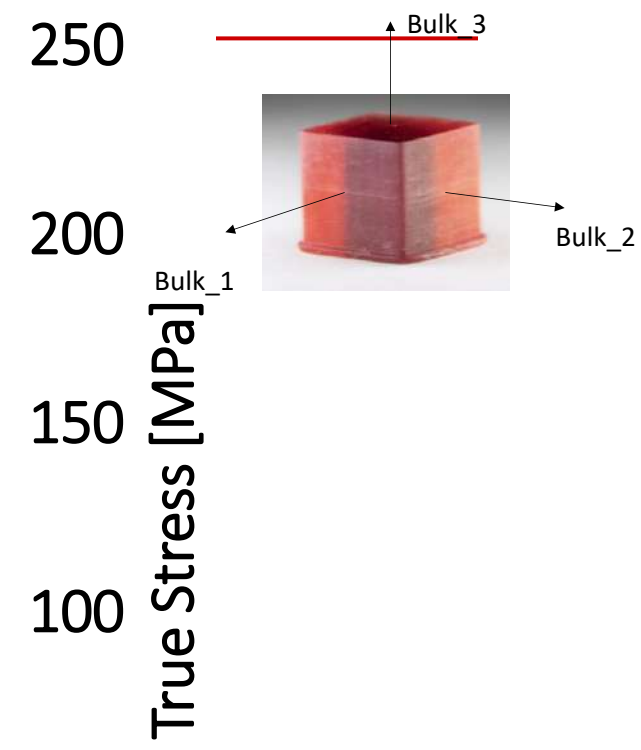
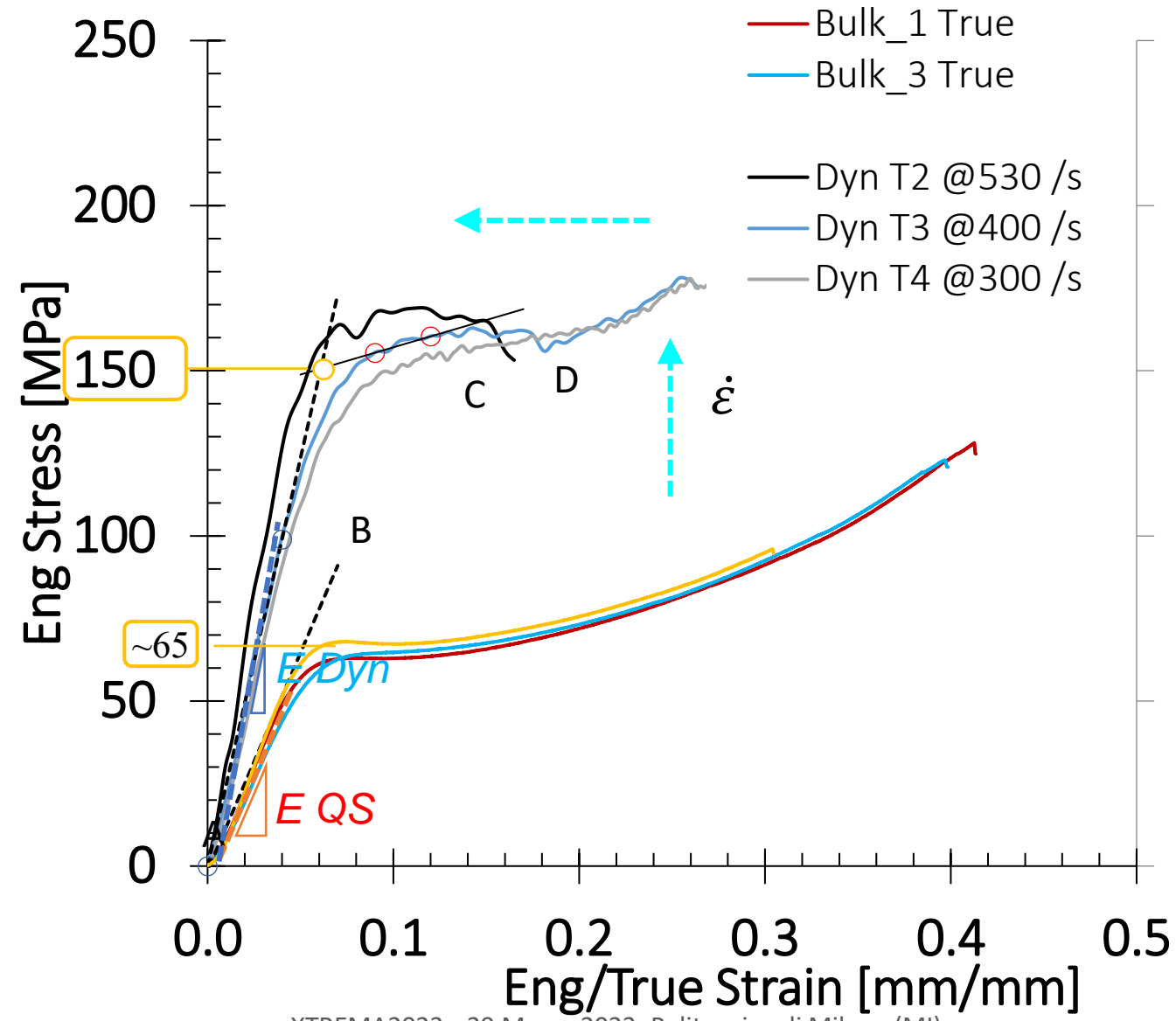
- Campioni stampati

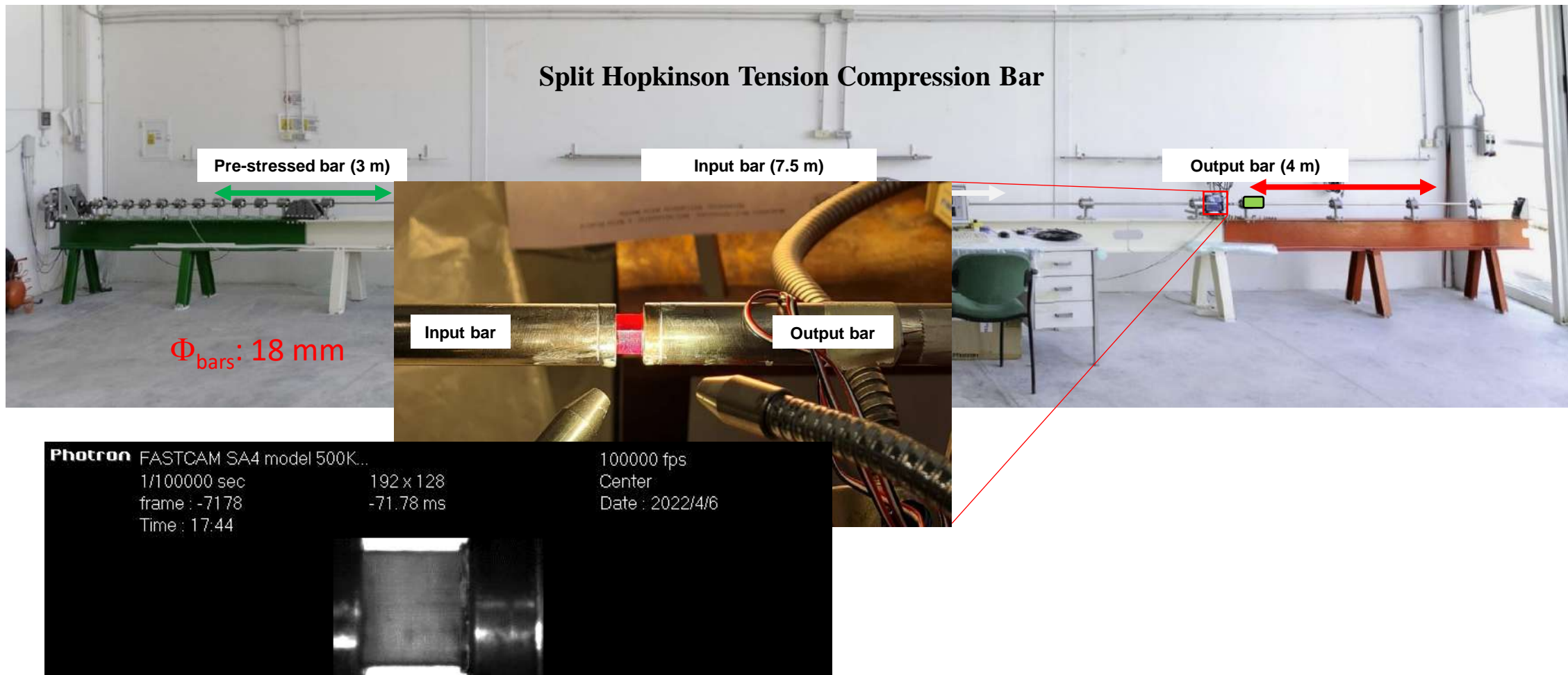


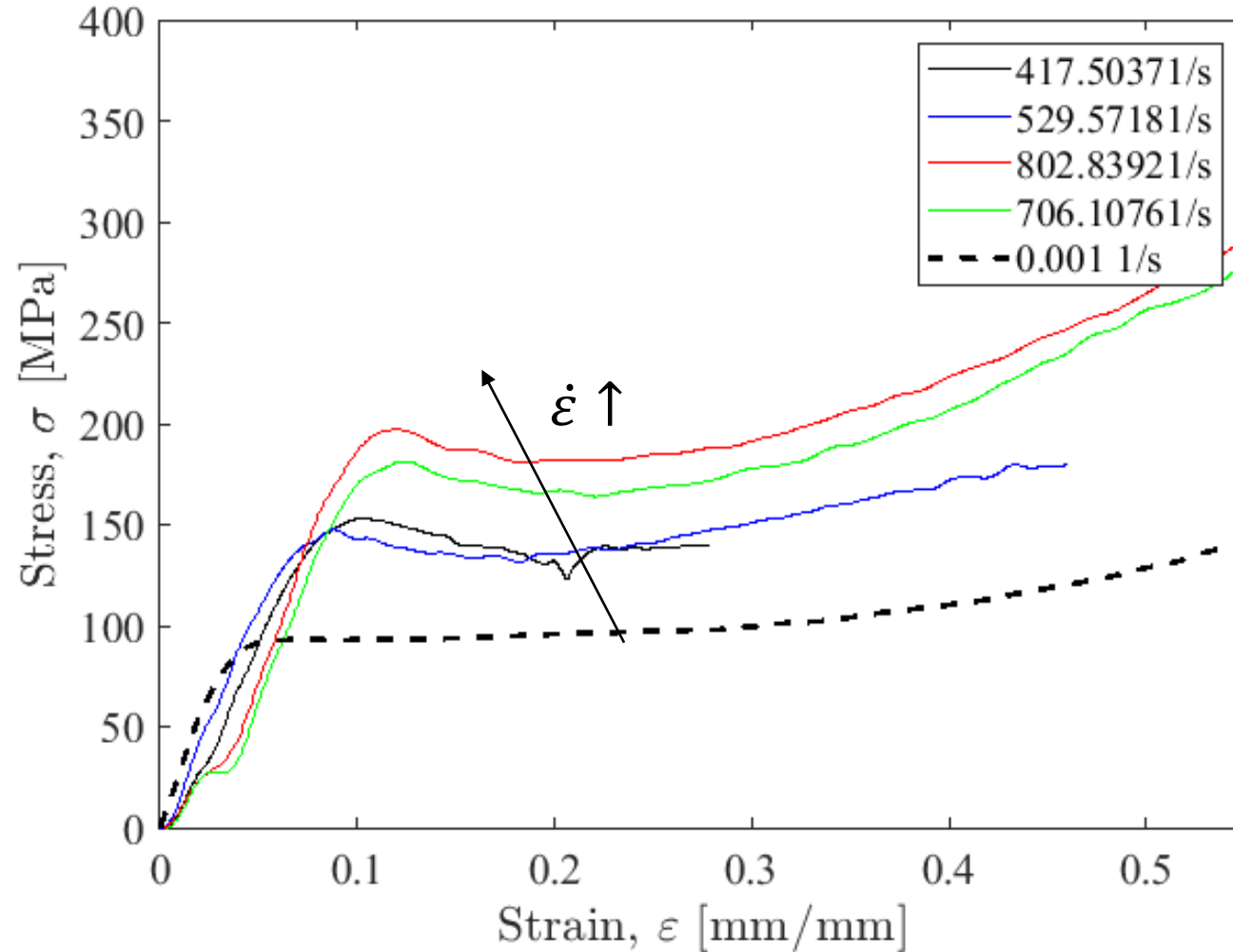


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Resina epossidica









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PEI/CNT



Photron FASTCAM SA4 model 500K...

1/150000 sec

frame : -11495

Time : 10:08

128 x 96

-76.633333 ms

150000 fps

Center

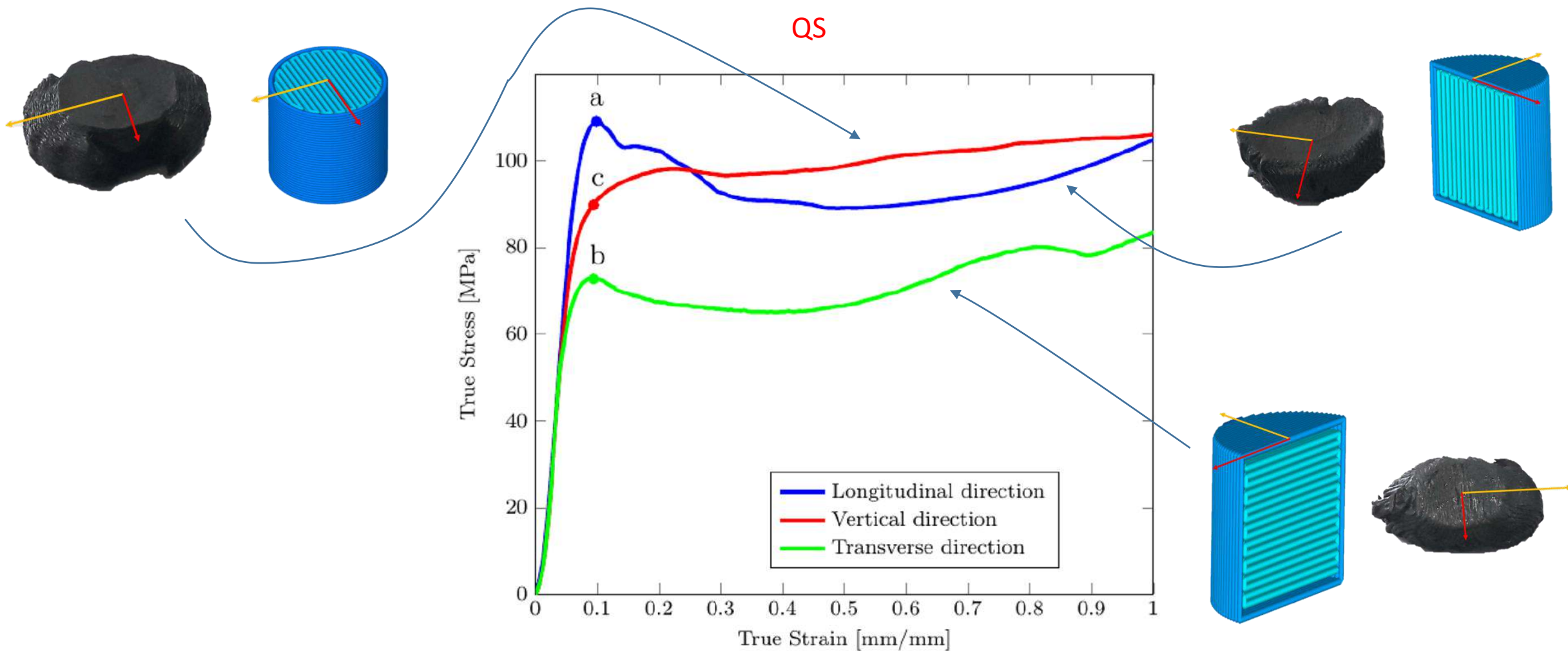
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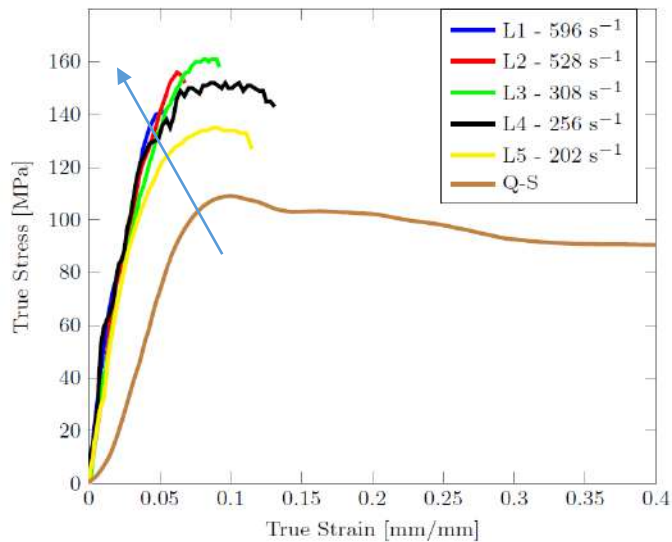
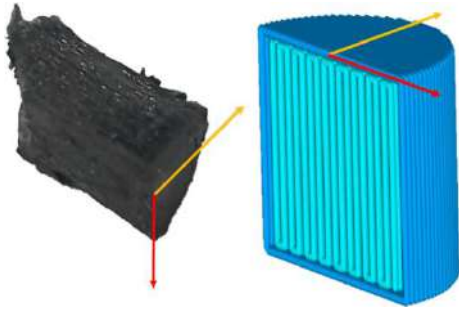
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Carbon-PA

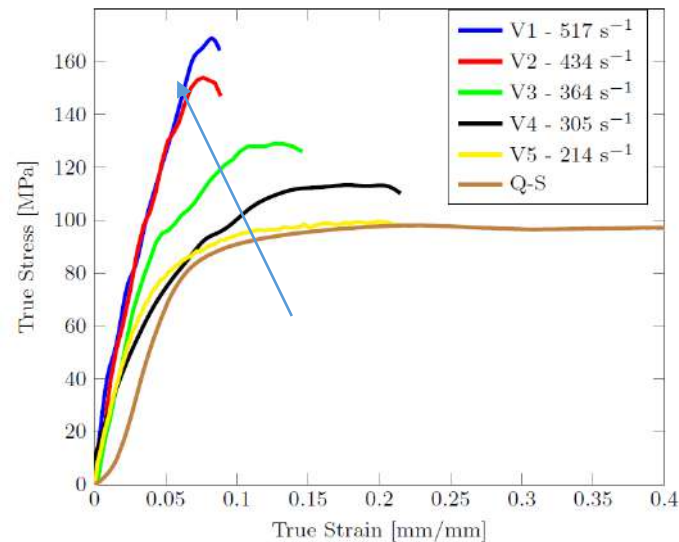
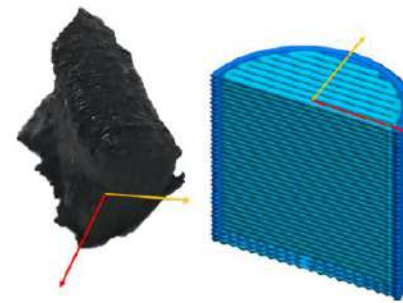


Dyn

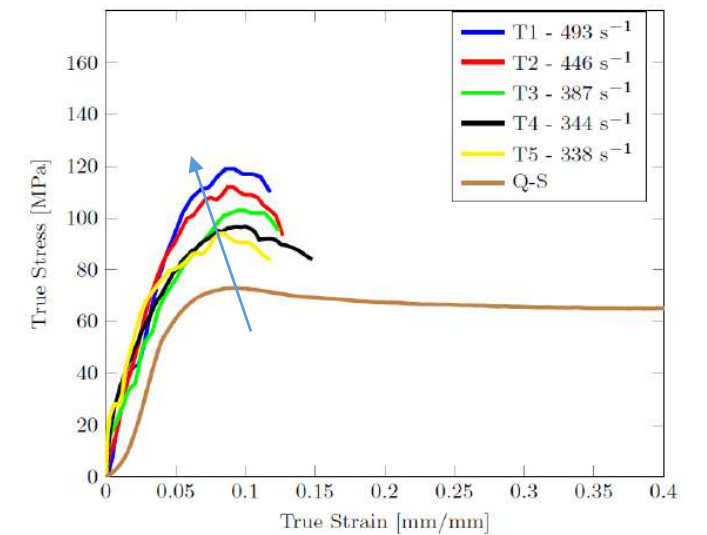
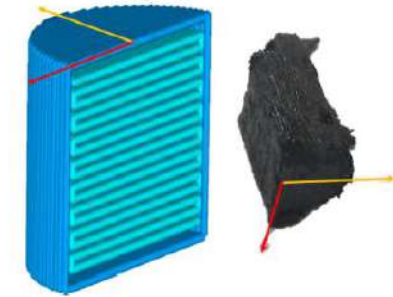
Longitudinal direction

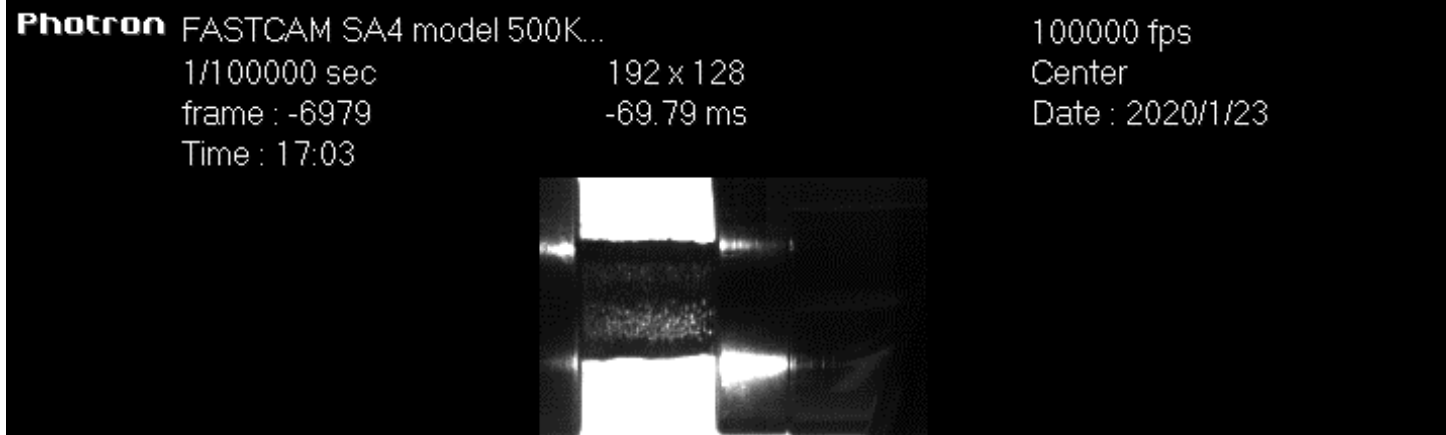


Vertical direction

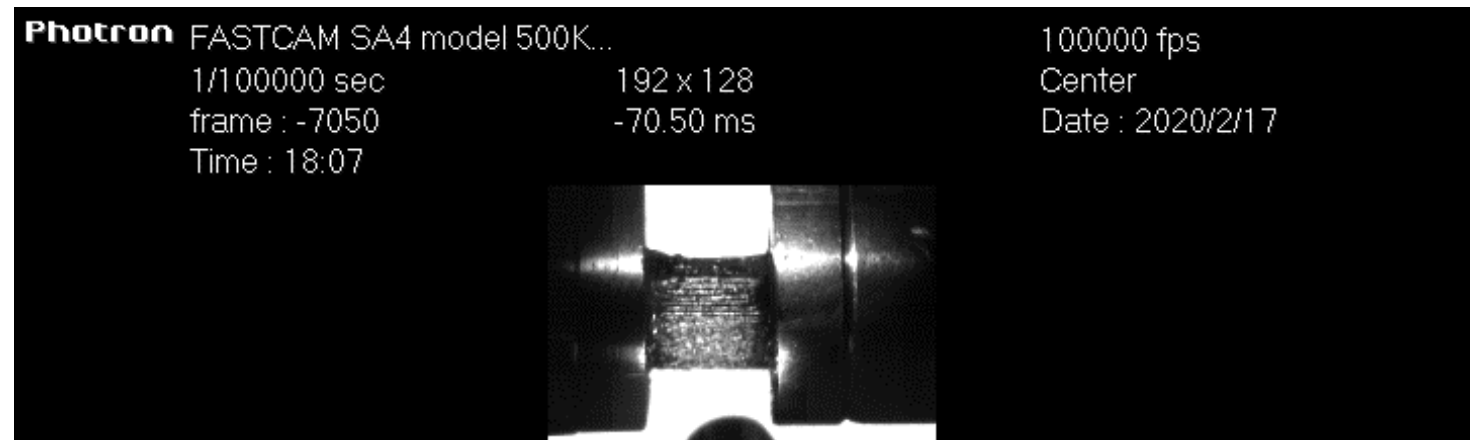


Trasverse direction





Trasversale

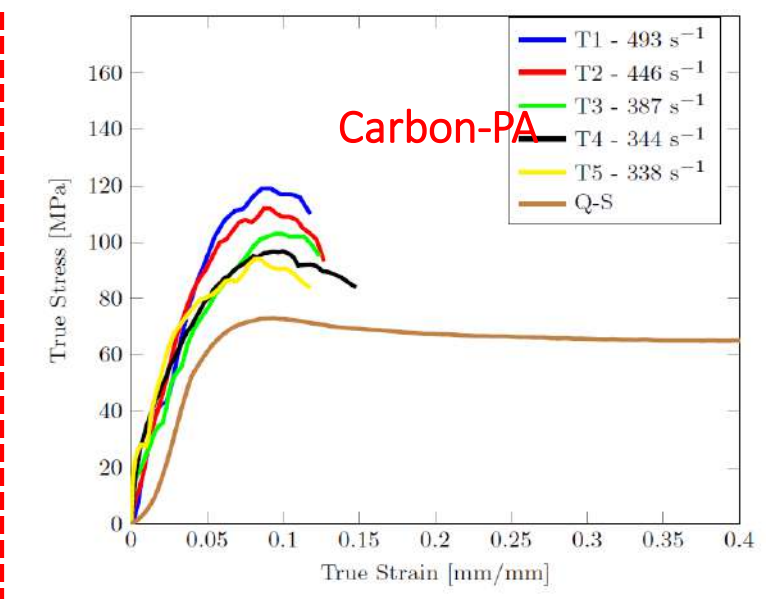
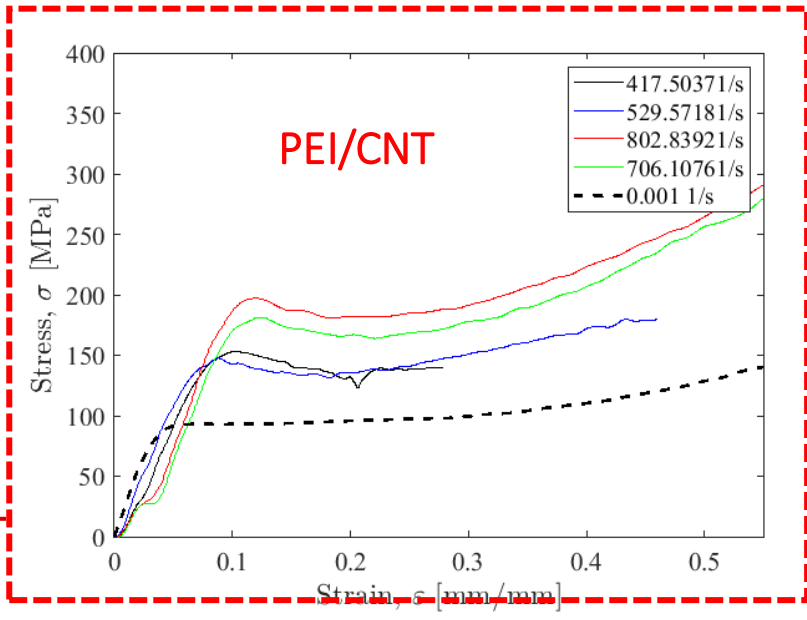
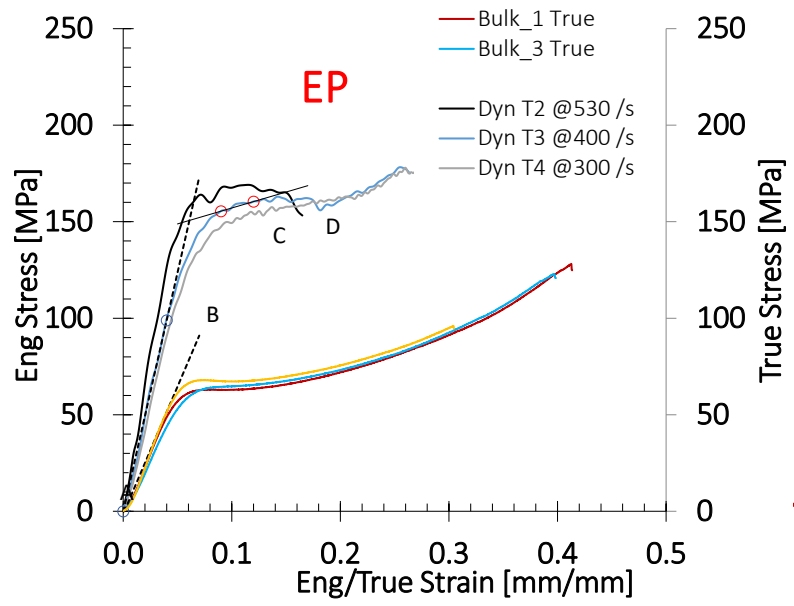
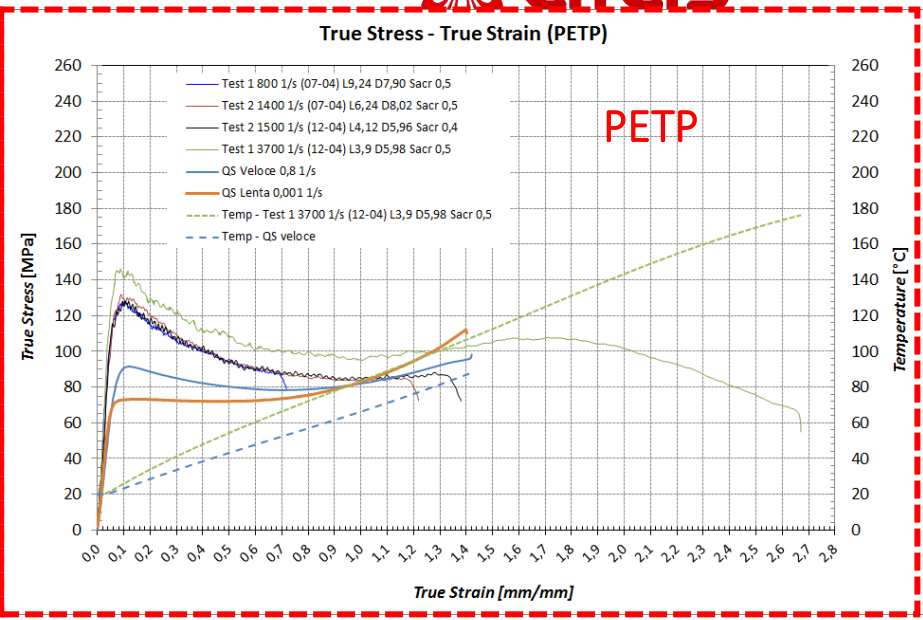
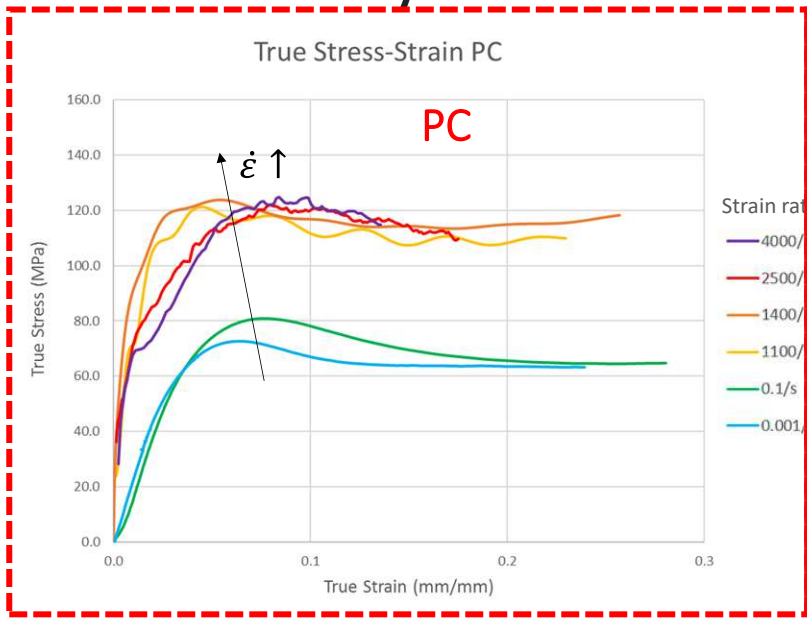
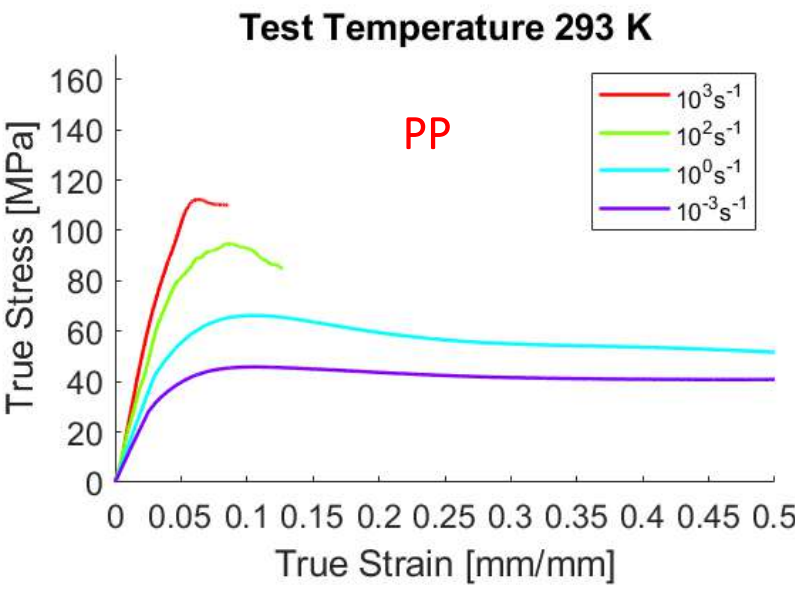


Longitudinale



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Summary



Conclusioni

- ◆ Polimeri investigati:

PP, PETP, PC, PMMA, EP, PEI/CNT, Carbon-PA

- ◆ Non tutti i polimeri investigati presentano un'instabilità legata alla concentrazione della deformazione in narrow bands (ASB)
- ◆ La classe del polimero non sembrerebbe essere dirimente sulla formazione della ASB
- ◆ La resina epossidica ha un comportamento brittle e/o manifestante una instabilità solo ad alto strain rate
- ◆ PEI/CNT e Carbon-PA hanno un comportamento differente probabilmente dovuto al rinforzo; nel primo abbiamo nanotubi, nel secondo fibra corta

Lavoro futuro:

- ◆ Coinvolgere CHIM/05!!!!



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***INDAGINE SU ALCUNI POLIMERI E LA TENDENZA CHE HANNO A
FORMARE SHEAR BAND AD ALTO STRAIN RATE***

Grazie per l'attenzione!

Mancini Edoardo

Unimi (ITALY)

29/03/2023