Phase transitions in porous materials under shock loading

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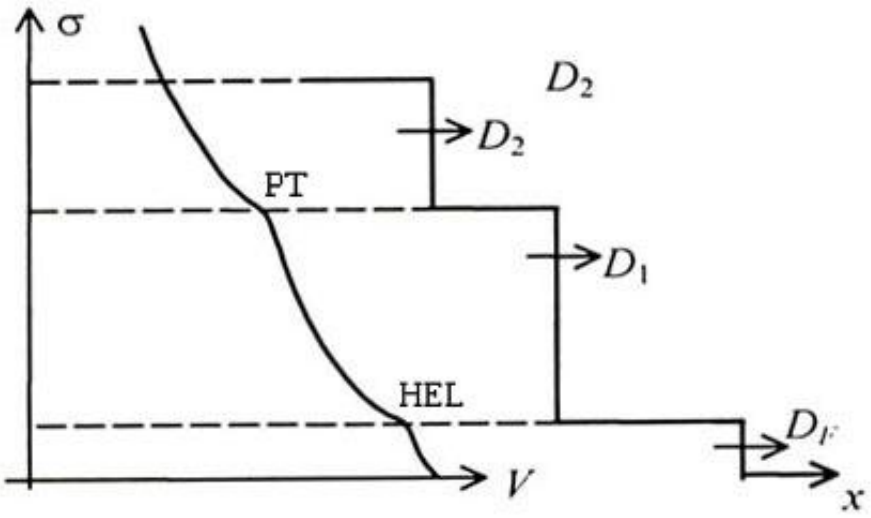
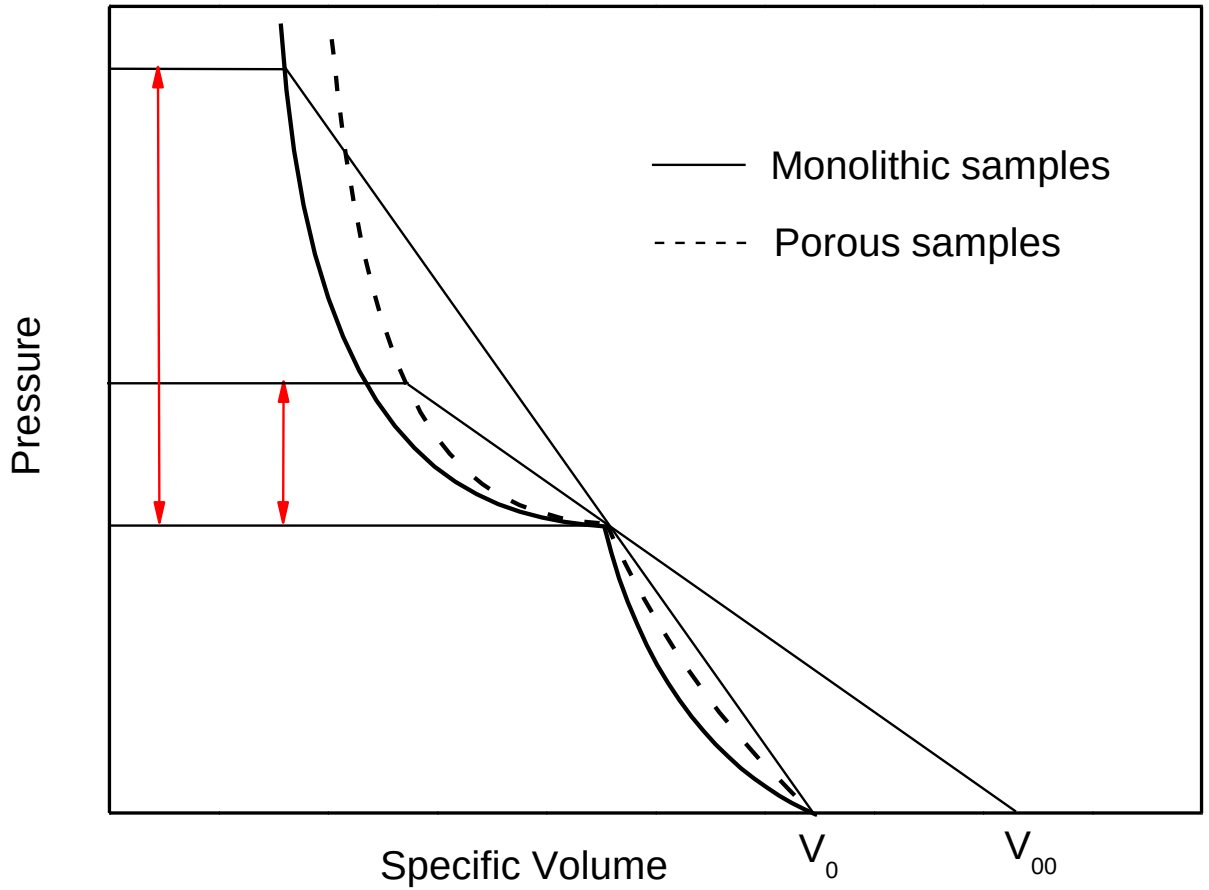


Fig. 1. Schematic Hugoniot and appropriate shock wave profile [1].

SHOCK COMPRESSION OF POROUS MATERIAL

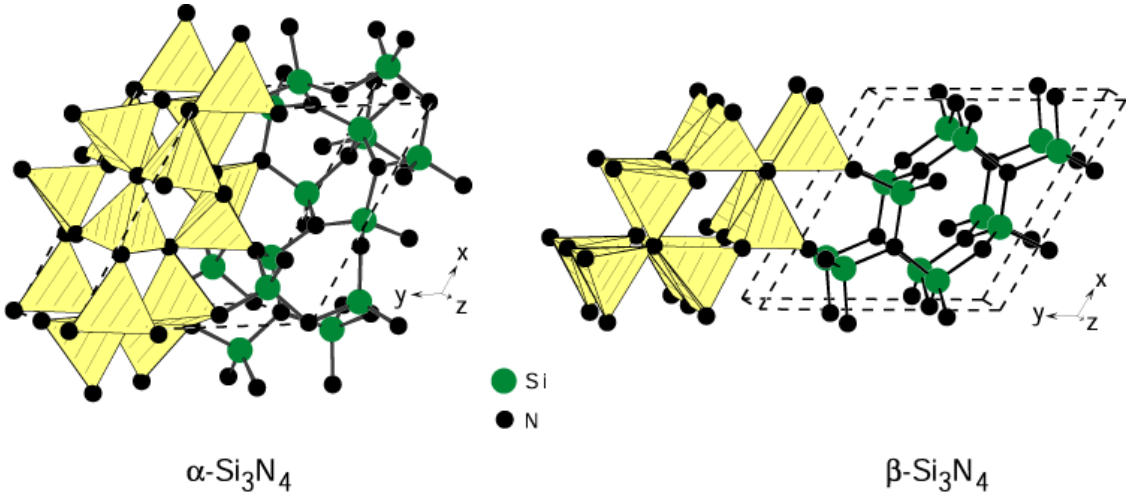


SILICON NITRIDE CRYSTALLINE MODIFICATIONS

α - rhombohedral Si_3N_4

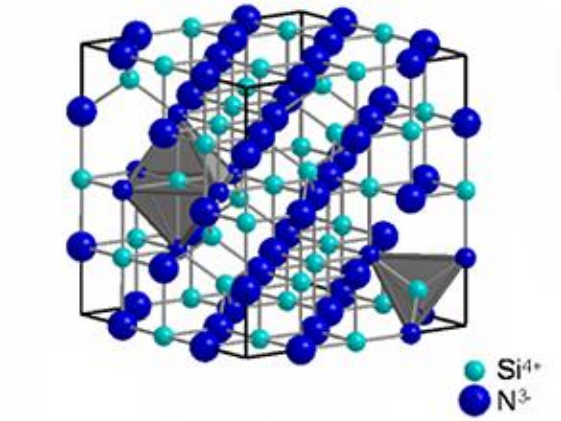
β - hexagonal Si_3N_4

www.hardmaterials.de



c - cubic Si_3N_4

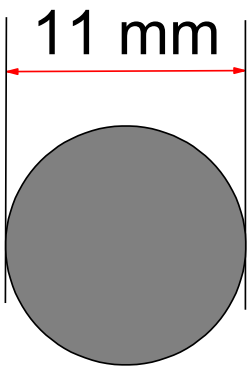
****www.mawi.tu-darmstadt.de***

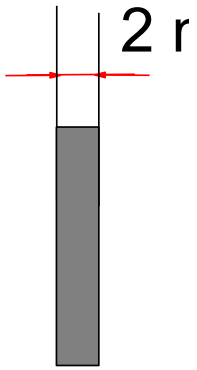


c - Si_3N_4 synthesis:

1999 - Zerr A. et al – in diamond anvil cell from amorphous Si_3N_4
2000 - Sekine T. et al – in shock waves from β – Si_3N_4
2006 - Tatsii V.F. et al – by detonation methods from β – Si_3N_4

SAMPLES



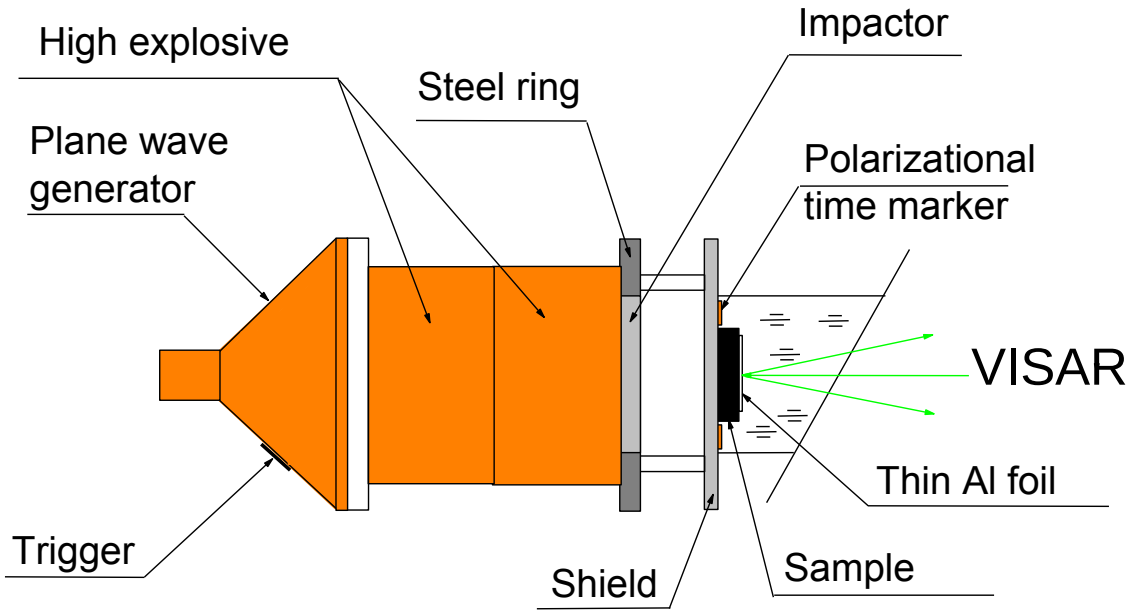


β-Si_3N_4:

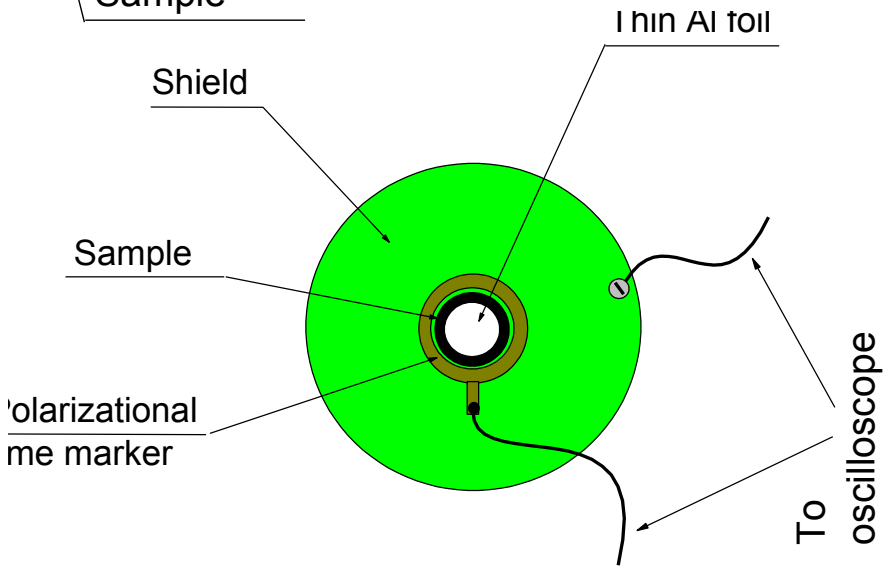
$\rho_{cryst.}$ = = 3,24 g/cm^3

$\rho_{por.}$ = 0,85 ρ_{cryst} = 2,72 g/cm^3

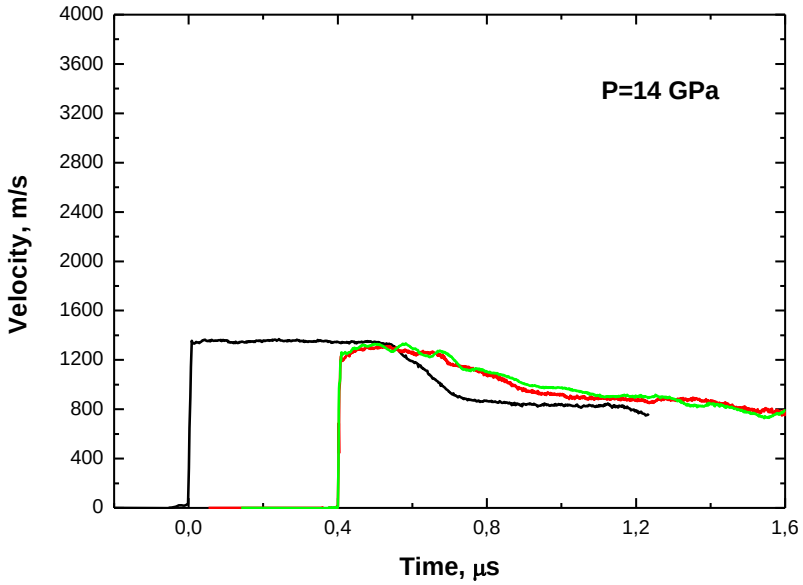
EXPERIMENTAL SETUP

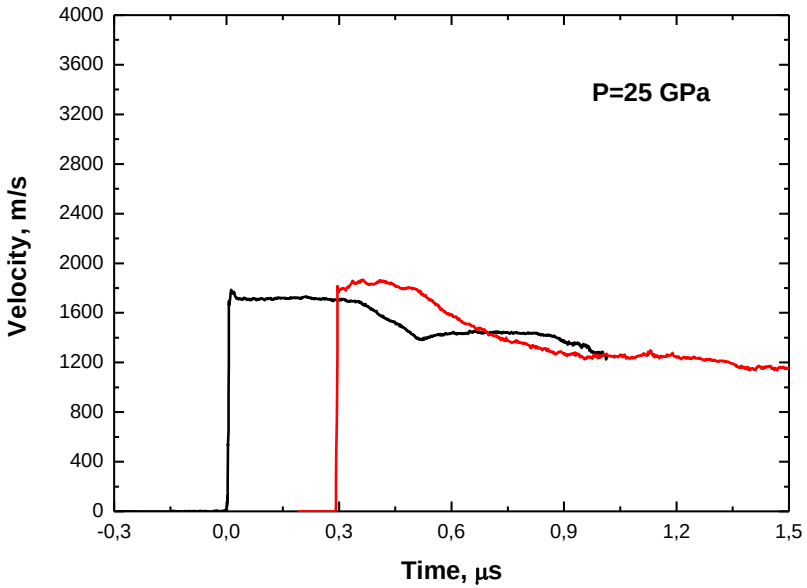


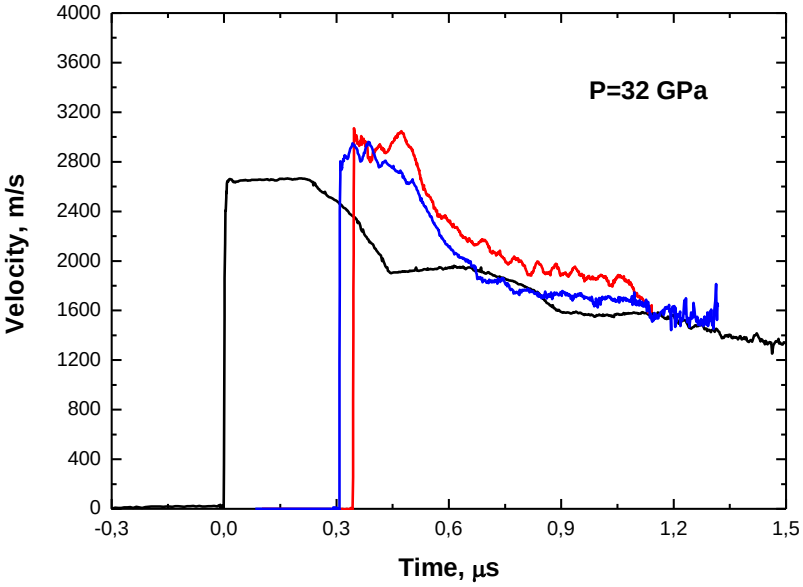
Frontal view

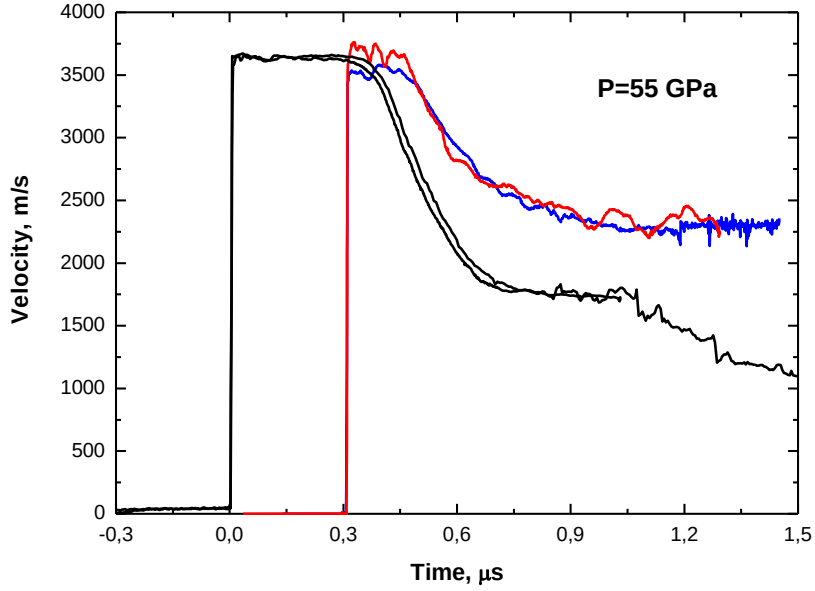


EXPERIMENTAL PARTICLE VELOCITY PROFILES (VISAR)

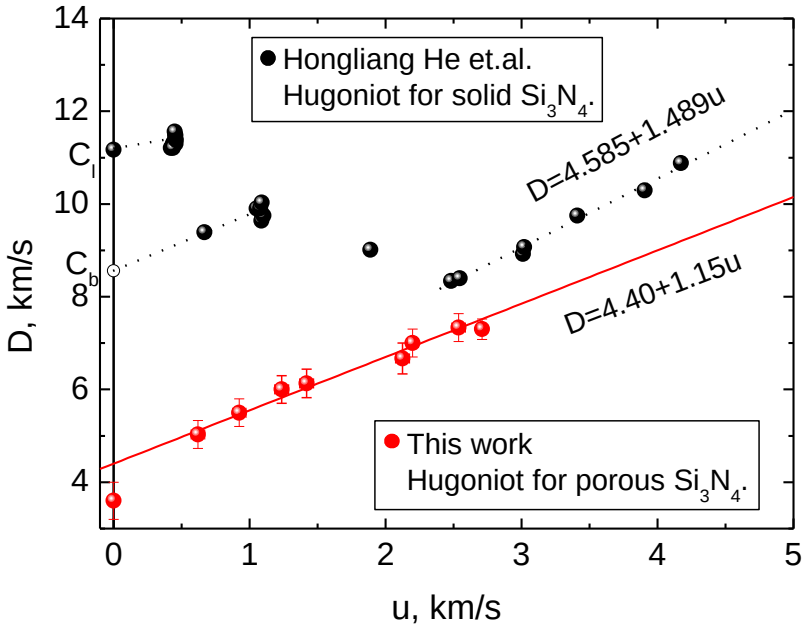




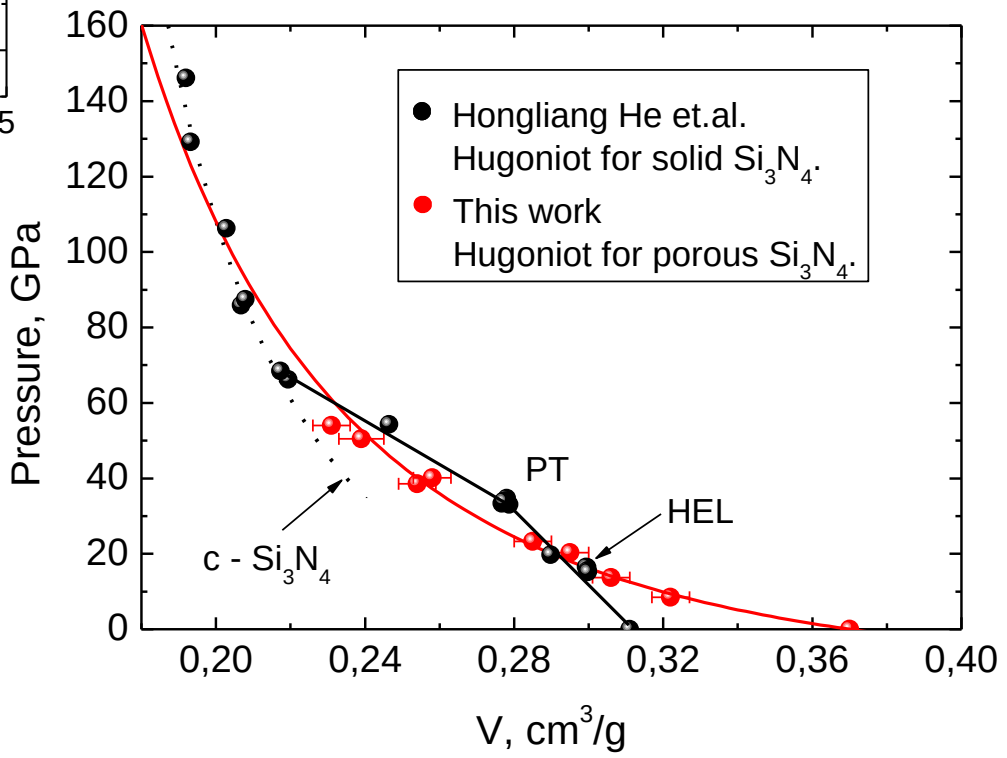




Si_3N_4 HUGONIOT



Pressure vs. specific volume



Shock wave velocity vs. particle velocity.
Black points - Hongliang He et al. // Phys. Rev. B. Vol. 62, Num. 17. 2000.

SUMMARY

Proton radiography methods allow to determine with better accuracy the Hugoniot behavior features on P-V plane.

Simultaneous temperature determination with precise Hugoniot measurements allow to construct the transition pressure dependence on temperature in the case of absence of closed region on the Hugoniot.

It is shown on the example of silicon nitride that proton radiography can be effective in investigation of phase transitions when traditional methods do not work.

Thank you for your attention!