Molecular Dynamic Simulations on Shocked Silica Glass

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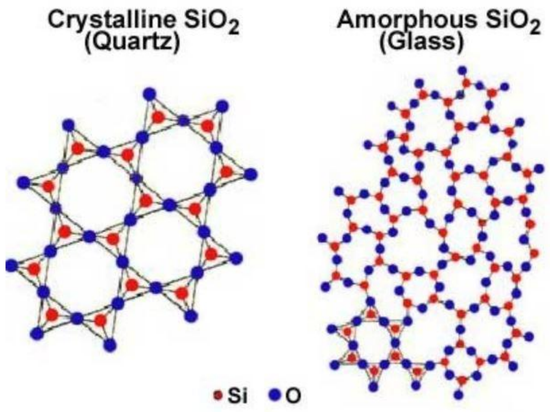
Does the cooling time of silica glass effect its properties under high pressure shocks?

Objective:

Discover optimal quench time for silica glass to dissipate energy from high pressure shocks.

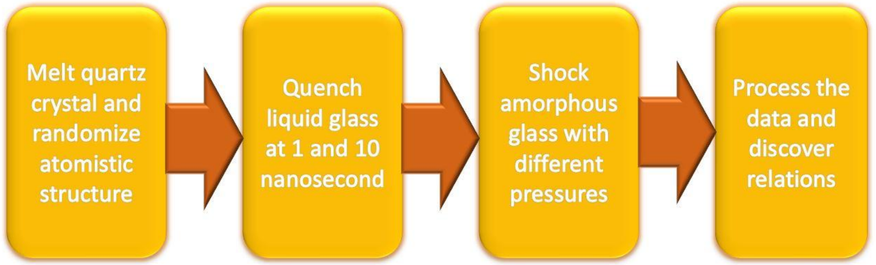


Application:

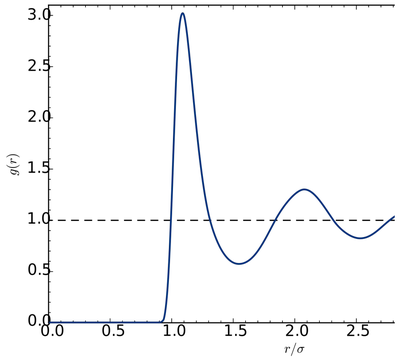
Build superior defense systems from glass to defend against hypervelocity ballistic impacts. This is a new breed of modern weapons.

Rail gun concept for 2025 Chinese destroyer

Method:



Atomistic Structure:



It is expected that decreases in patterned structure within the glass will result in increased melting under shocks resulting in better energy absorption.

Governing Equations:

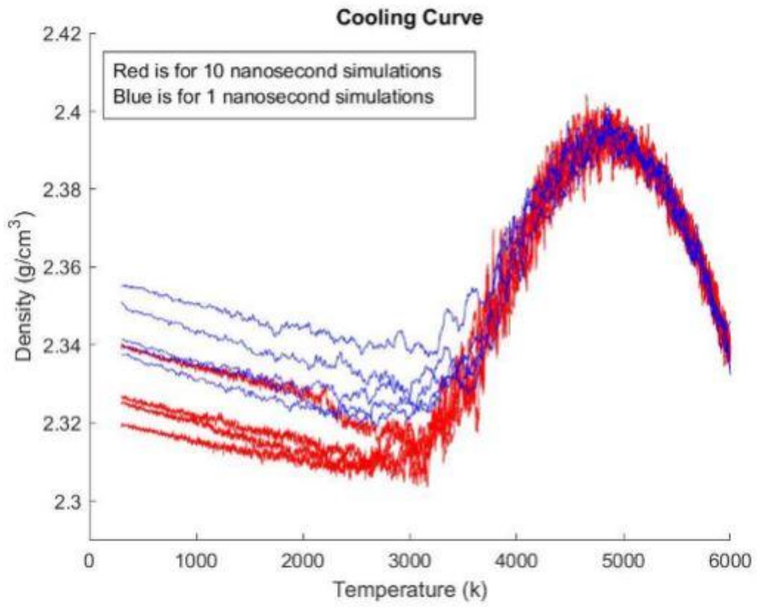
$$\rho_1 u_1 = \rho_2 u_2 \equiv m \qquad \text{Conservation of mass}$$

$$\rho_1 u_1^2 + p_1 = \rho_2 u_2^2 + p_2 \qquad \text{Conservation of momentum}$$

$$h_1 + \frac{1}{2}u_1^2 = h_2 + \frac{1}{2}u_2^2 \qquad \text{Conservation of energy}$$

$$T_t - T = \frac{\left(\frac{1}{2}(P+P_0)(V_0-V)+E_0-E\right)}{N_{dof}k_B} = \Delta$$

Results:



Properties of Shock Simulations				
Test	Time ns	Density g/cm^3	Pxx Bar	Tempature K
1	1	3.785	200193	845
1	10	3.782	199927	821
2	1	4.198	394839	2151
2	10	4.259	400073	2216
3	1	4.483	600386	3408
3	10	4.483	600067	3437
4	1	4.667	800583	4567
4	10	4.666	800455	4602
5	1	4.839	998382	5776

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