A case for robust micromechanical models

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Micromechanical models

- Integrated average quantities are expressed as functions of melt fraction
  - Permeability
  - Viscosity
  - Surface tension
- Controls on melt geometry
  - Melt fraction
  - Interfacial tensions
  - State of stress
- Robust micromechanical models include force balance *within control volume*

Melt fraction and viscosity

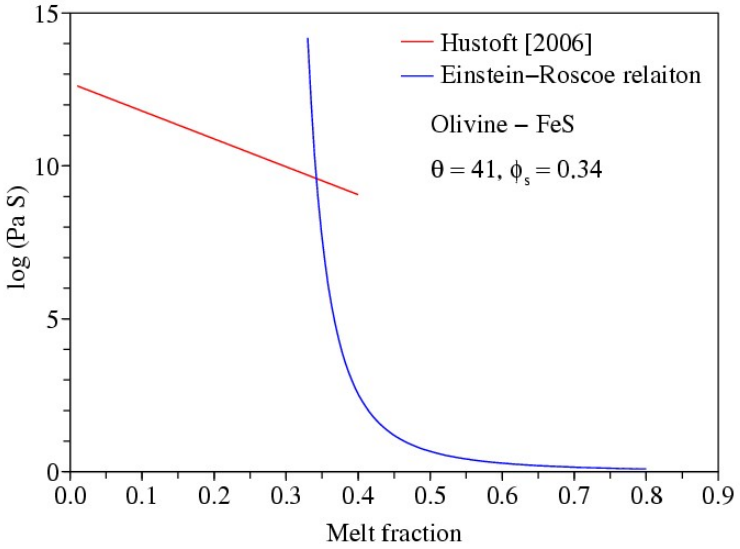
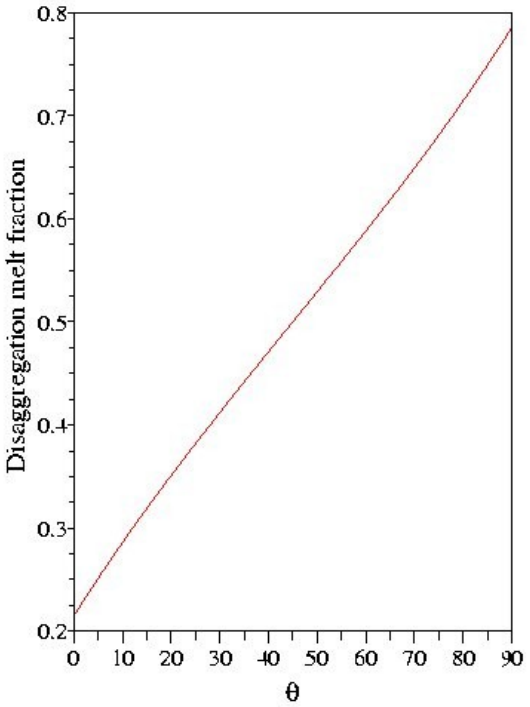
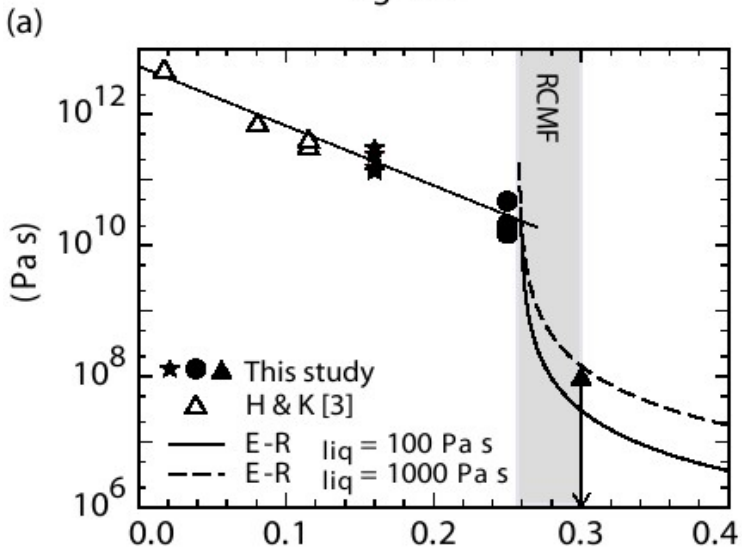
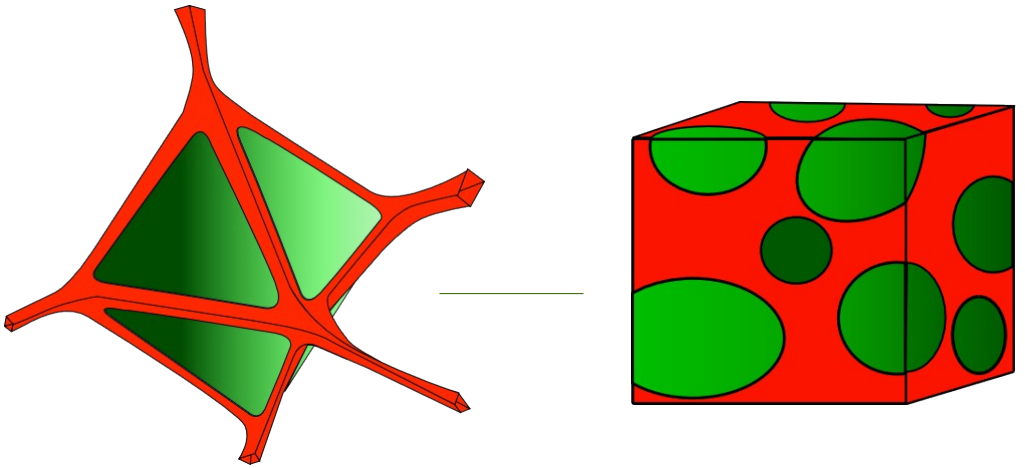


Figure 7

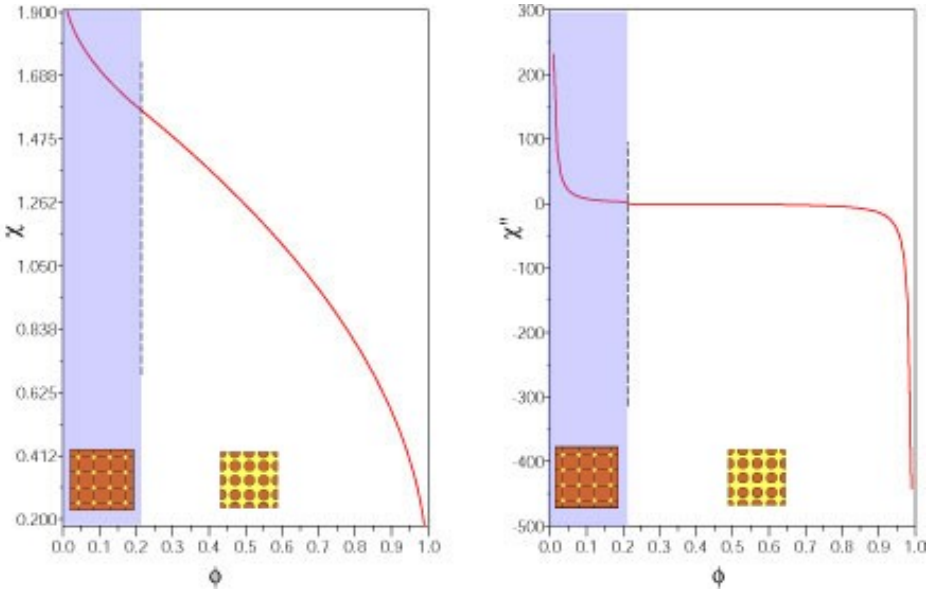


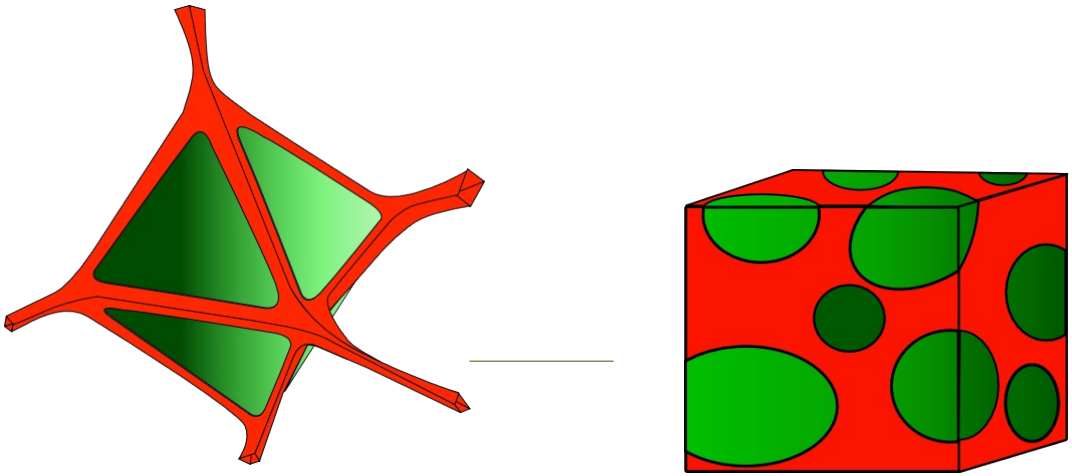




Scott and Kohlstedt, [2006].

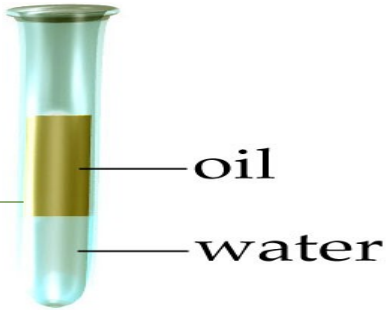
Melt fraction and surface tension





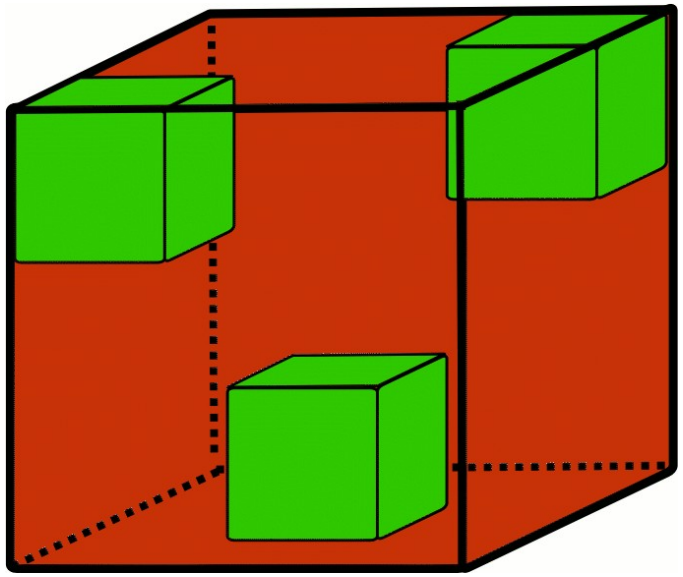
$$\chi(\phi)=\left(\chi_1-2\cos\theta\,\chi_2\right)\sqrt{\phi}+2\cos\theta \quad if \quad \phi<\phi_s$$

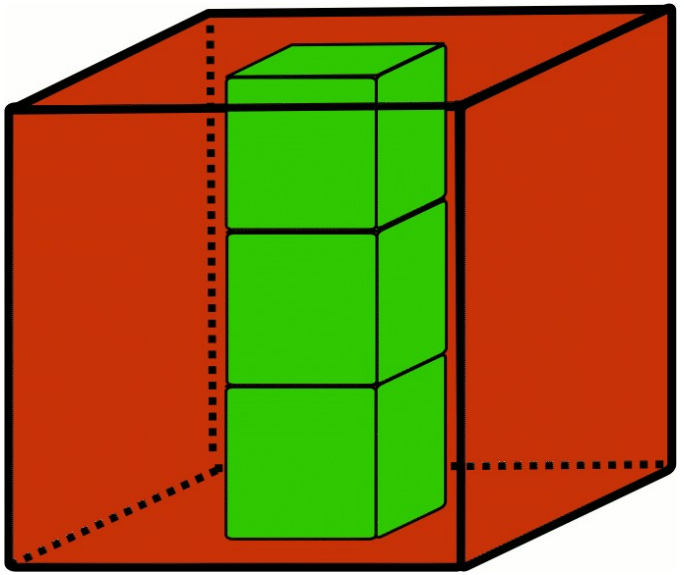
$$\sqrt{\frac{\pi}{4}(1-\phi)} \quad if \quad \phi\geq\phi_s$$



Hier-Majumder et al, [2006].

A simple illustration





$$\phi = 3a^3 / b^3$$

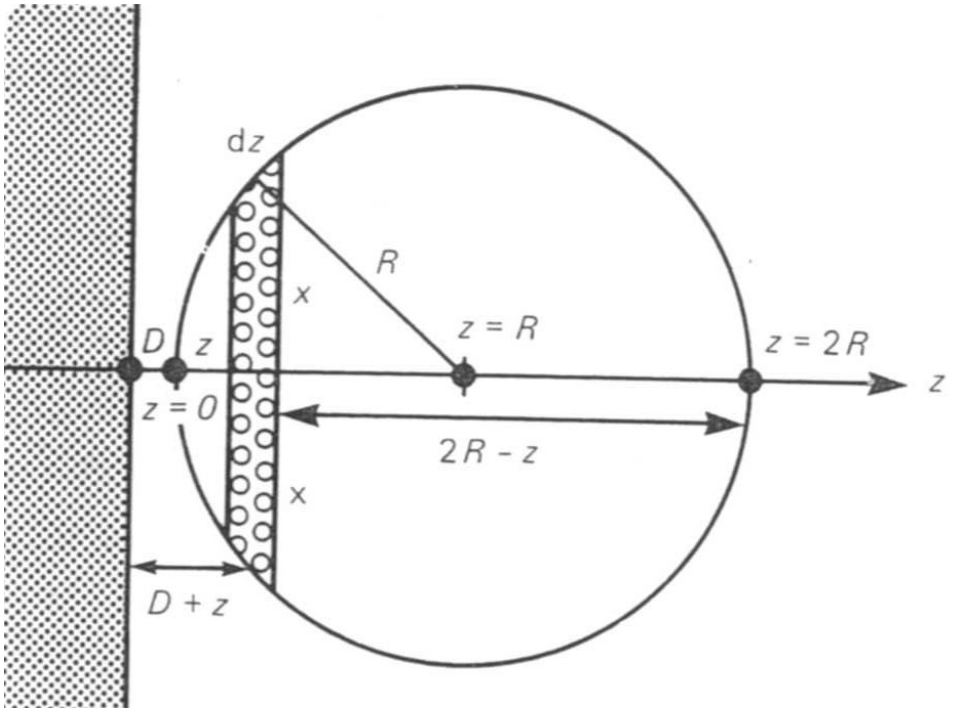
$$\alpha_{sl} = 18a^2$$

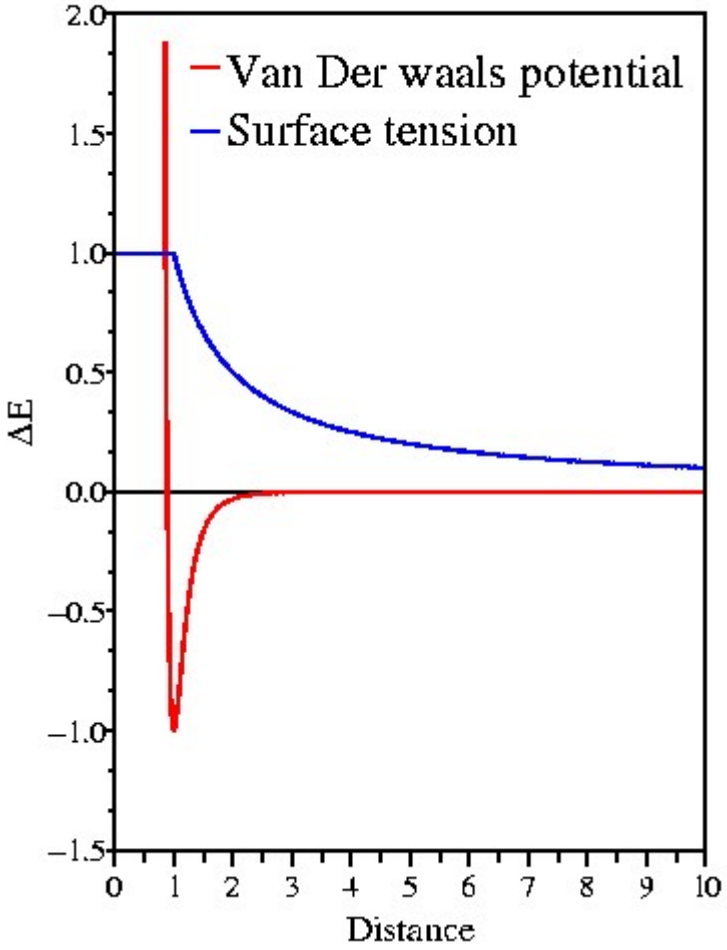
$$\alpha_{ss} = 0$$

$$\alpha_{sl} = 14a^2$$

$$\alpha_{ss} = 2a^2$$

Grain scale force balance





Israelachvili [1991]

Hier-Majumder and Bercovici *[2006]*

Robust micromechanical models

- Melt geometry
  - Drop dynamics/ interfacial flow
  - Solid harmonics
  - Boundary Integral Method
- Physical properties
  - Permeability
  - Viscosity
  - Shear wave velocity