"Numerical simulation of the convective heat transfer on high-performance computing systems"

<https://www.allanswered.com/post/awakk/how-to-convert-stress-power-tensor-in-navier-stokes-into-scaler-heat-source/>

Viscous heating is given by  
  
Q=˙ϵijτij=˙ϵ:τ=tr(˙ϵ⋅τ)=2μtr(˙ϵ⋅˙ϵ)  
with symmetric part of the strain-rate tensor ˙ϵ, viscosity μ and deviatoric stress tensor τ.  It can be stated as a FEniCS form via

# velocity `u` and viscosity `mu` :

epsdot = 0.5 \* (grad(u) + grad(u).T) # strain-rate

tau = 2.0 \* mu \* epsdot # dev. str.

sigma = tau - p\*Identity(3) # Cauchy str.

Q = inner(epsdot, tau)​

Q\_also = tr(dot(epsdot, tau))

Q\_again = 2 \* mu \* tr(dot(epsdot, epsdot))