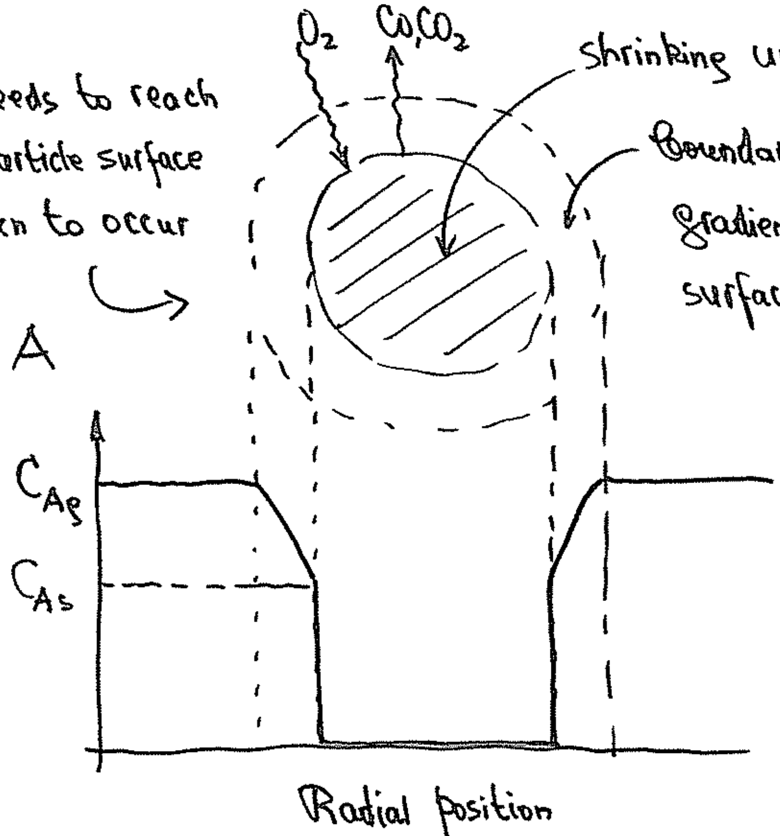
FSc 401
FSc 430 Intro to Transport phenomena / Coal Combustion
EGEE 510 (or that of any solid)

Example of (inevitably coupled) mass transport and chemical kinetics

– coal combustion : essential (for many years to come?) for electricity generation ⇒ minimize air pollution !?

O_2 needs to reach the particle surface for rxn to occur

$O_2 \equiv A$



At steady state,
Rate of rxn on the surface
=
Rate of diffusion to the surface
!!!

At steady state: $A + bB \rightarrow$ products

$$-\frac{1}{S_{ex}}\frac{dN_B}{dt} = b k_g (C_{Ag} - C_{As}) = b k_{rxn} C_{As}$$

def of rate — rate of mass transport — rate of rxn

$$\left[\frac{\text{moles B}}{m^2 \cdot s}\right] \quad \left[\frac{\text{mol B}}{\text{mol A}}\ \frac{m}{s}\ \frac{\text{mol A}}{m^3}\right] \quad \left[\frac{\text{mol B}}{\text{mol A}}\ \frac{1}{s}\cdot\frac{\text{mol A}}{m^3}\right]$$

* See also Section 27.2 in Atkins[7]!! $k = \frac{k_g k_{rxn}}{k_g + k_{rxn}}$

Don't know C_{As} (difficult to measure interfacial / surface conc.)

$$\Rightarrow C_{As} = \frac{k_g C_{Ag}}{k_g + k_{rxn}} \Rightarrow \boxed{\text{Rate} = \frac{b}{\frac{1}{k_g} + \frac{1}{k_{rxn}}} C_{Ag}}$$

$\tau \propto \frac{1}{k}$; etc.

Remember Phys 101