Supporting Information for:

Reactive Transport with Fluid-Solid Interactions in Dual-Porosity Media

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1. Intensity vs. Concentration: Calibration Curves

Experiments were carried out using fluorescence microscopy, by monitoring the light intensity of the chemical reaction (see section 2.1 in the manuscript). Calibration curves were measured to convert the light intensity to concentration of the reaction product C (fluorescent compound: 4-methylumbelliferone). Figure S1a shows the calibration curve for the single grain system (Section 3.1 in the manuscript), and Figure S1b for the porous media system (section 3.2 in the manuscript).

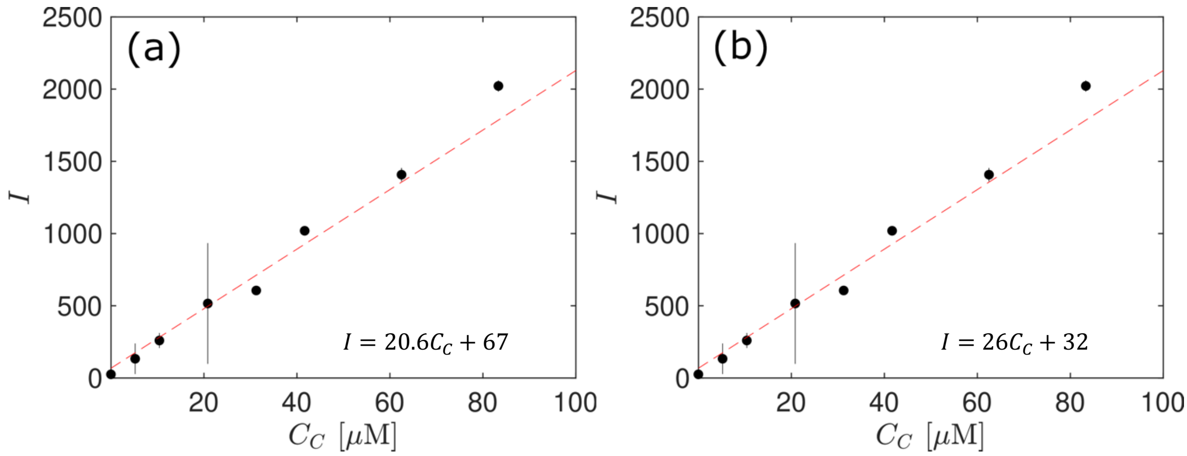

Figure S1: Calibration curves used to convert image intensity (I) to concentration (C_C, concentration of the fluorescent compound: 4-methylumbelliferone), for the (a) single grain and (b) porous media experiments.

2. Validation of the Numerical Simulations

In addition to the laboratory experiments, numerical simulations were used to expand the range of Péclet (Pe) and Damköhler (Da) numbers under consideration. Table S1 shows the model parameters used to validate the numerical model against the experimental observations (section 3.2 in the manuscript). Note that while most of the model parameters were measured and used as constants in the model, three parameters were fitted by the experimental results: the hydrogel grains permeability (κ) and porosity (ϕ_h), and the enzyme concentration on the hydrogel grains surface (E_0).

Table S1: Parameters used in the numerical simulations to validate the experimental results; $\bar{v}$ is the fluid average velocity, D is the molecular diffusion coefficient, κ is the grain permeability and ϕ_h is the grain porosity.

Pe	Da	Re	$\bar{v}$ [m/s]	D [m²/s]	κ [m²]	ϕ_h [-]	E_0 [mol/m³]	C_0 [mol/m³ s]
50	0.2	6.95×10^{-2}	6.95×10^{-5}	1×10^{-9}	5.5×10^{-13}	0.5	1.22×10^{-6}	0.5
100	0.2	1.39×10^{-2}	1.39×10^{-4}	1×10^{-9}	5.5×10^{-13}	0.5	1.22×10^{-6}	0.5
500	0.2	6.95×10^{-1}	6.95×10^{-4}	1×10^{-9}	5.5×10^{-13}	0.5	1.22×10^{-6}	0.5