The Systematic Study of Porous Hydrogels to Measure Diffusion Induced by Hydrochloric Acid

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Abstract
- The goal was to systematically study the diffusion kinetics of the dissolution of Calcium Carbonate inside hydrogels induced by HCl
- PEDGA water solutions loaded with micron-sized calcite (up to 30% volume percent) particles were photopolymerized as flat monoliths and soaked into Hydrochloric Acid inducing the dissolution of the carbonates
- The dissolution fronts remain sharp throughout the reaction and progress inward in a diffusive manner, which can be described in a mean-field-diffusion-reaction that is limited by diffusion of the acid

Introduction
- Diffusion is the movement of particles from an area of high concentration to an area of low concentration
- The dissolution of the CaCO3 inside the PEDGA hydrogels is induced by an acidic solution, in this case Hydrochloric acid of different mole per liter concentrations
- This phenomenon leaves a hydrogel with some macroporosity originating from dissolved calcite

Procedure
- Utilizes a focused beam of high-energy electrons to generate a variety of signals at the surface of solid specimens
- Used for data are collection over a selected area of hydrogel sample after the diffusive dissolution

Results
- Diffusion Dissolution Kinetics
  - The variables that changed in this experiment were the concentration of the HCl and the CaCO3 concentration inside the hydrogel.
  - Different time measurements were taken with the logical assumption that the more time the hydrogel was soaked in HCl the less CaCO3 would remain inside the hydrogel and the more porosity would develop.
  - The diffusion reaction scheme fits a model of diffusion: square root of time
- pH Sensitive Dye Experiment
  - The hydrogels were soaked in water overnight and then put into a bath of hydrochloric acid of 1 M/L for 20 minutes fully dissolving the calcite and leaving a wet hydrogel with macroporosity, depending on %calcite
  - The porous hydrogel of various concentrations were then soaked into pH sensitive methyl orange dye of molar weight 327.33 g/mol.
  - The dye soaked hydrogels were then put into another bath of HCl of 1 M/L in front of a camera in order to measure the movement of the concentration front (range pH 3-4 where dye changes color).

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