

SUPPORTING INFORMATION

Micromodel Investigation of Transport Effect on the Kinetics of Reductive Dissolution of Hematite

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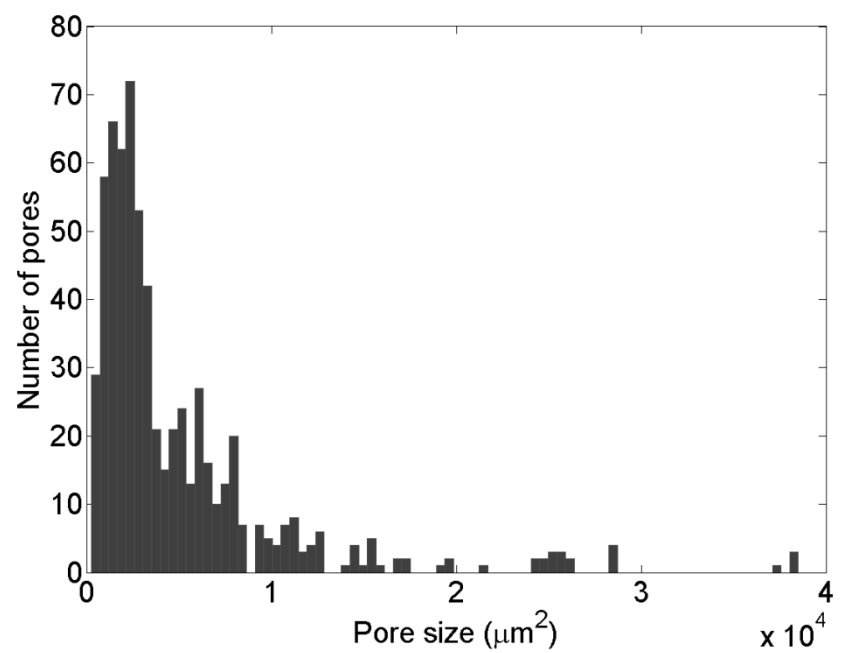


Figure S1. Pore size distribution of the micro-porous domains.

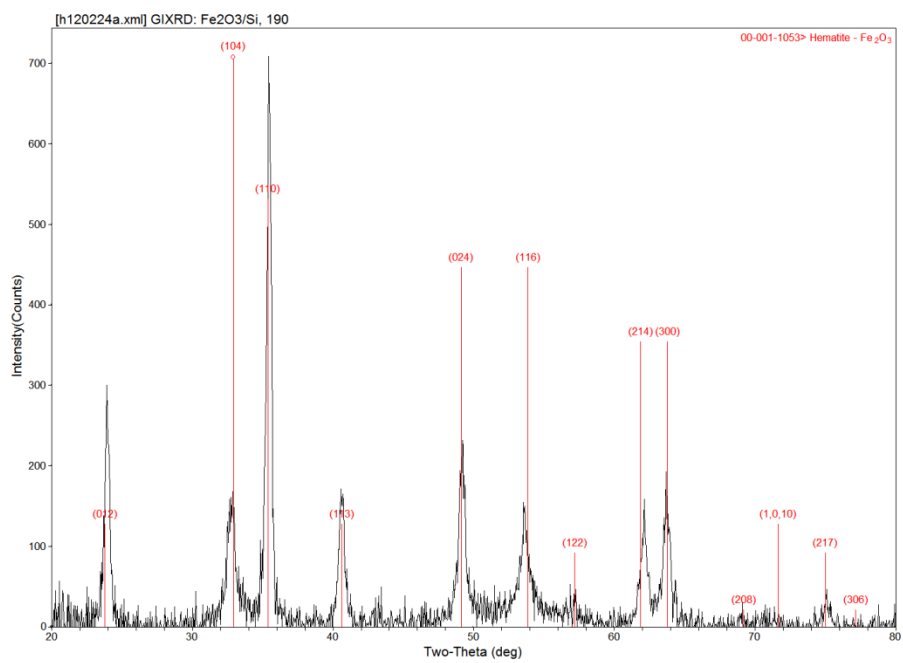


Figure S2. GIXRD spectra of sputter deposited hematite film on Si substrate.

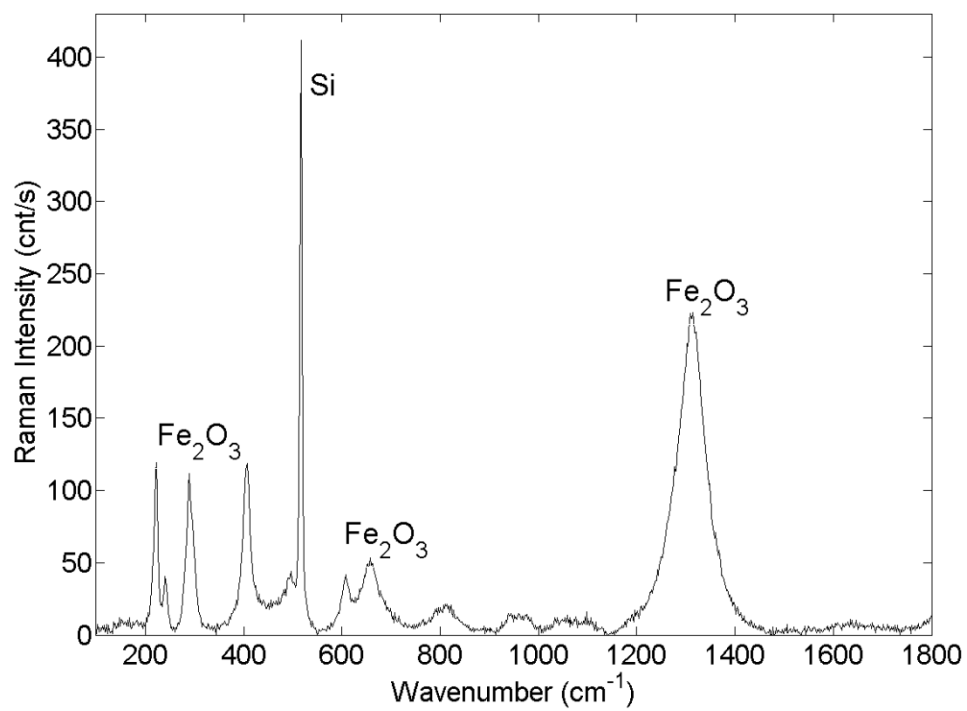


Figure S3. Representative Raman spectra of sputter deposited hematite film on Si substrate.

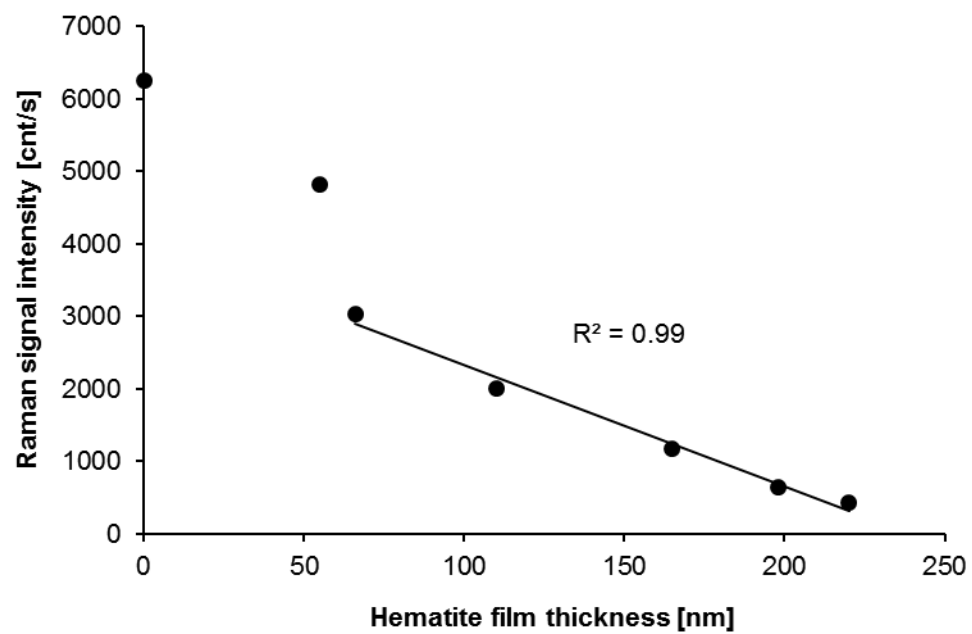


Figure S4. Raman signal intensity of Si vs. hematite film thickness.

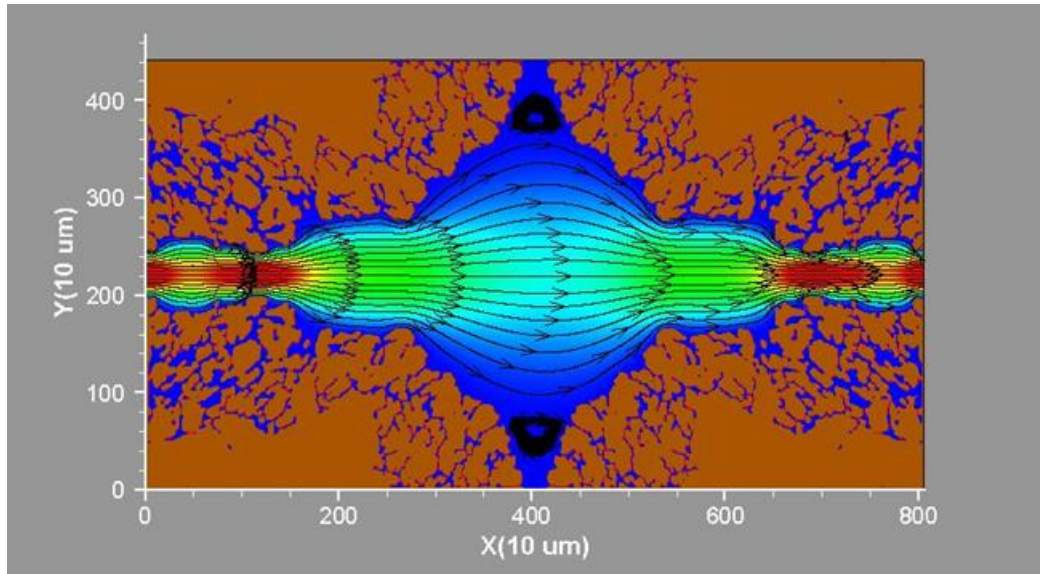


Figure S5. Calculated flow velocity field in the micromodel under experimental conditions, showing distinctive pore domain: advective domain denoted by changing colors and arrow streamlines; macropore domain representing the dead-end pores in the top and bottom center; and micropore domain in the intragranular pore spaces.

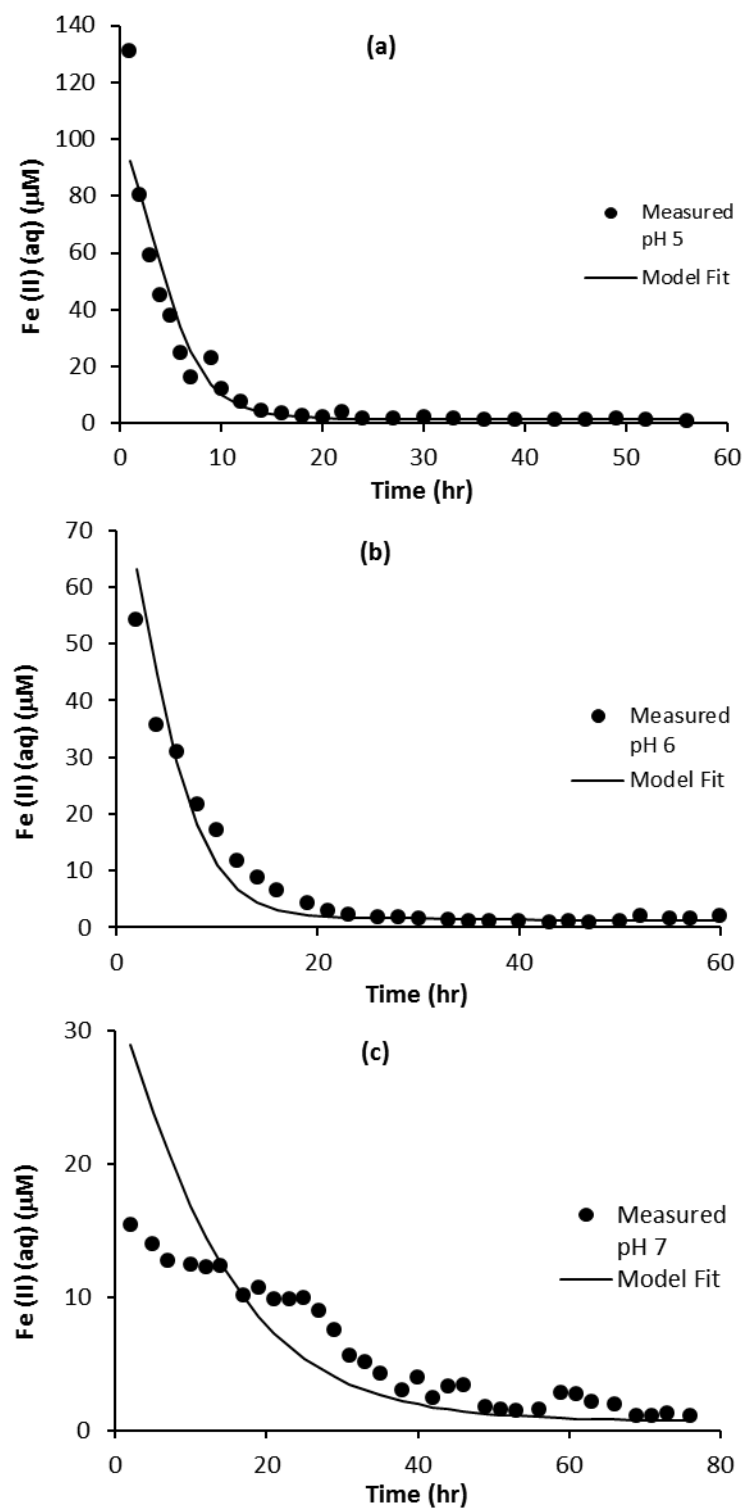


Figure S6. Fe(II) (aq) concentration measured in the micromodel effluent and calculated using the mass transfer model: (a) pH 5.0, (b) pH 6.0, (c) pH 7.0.

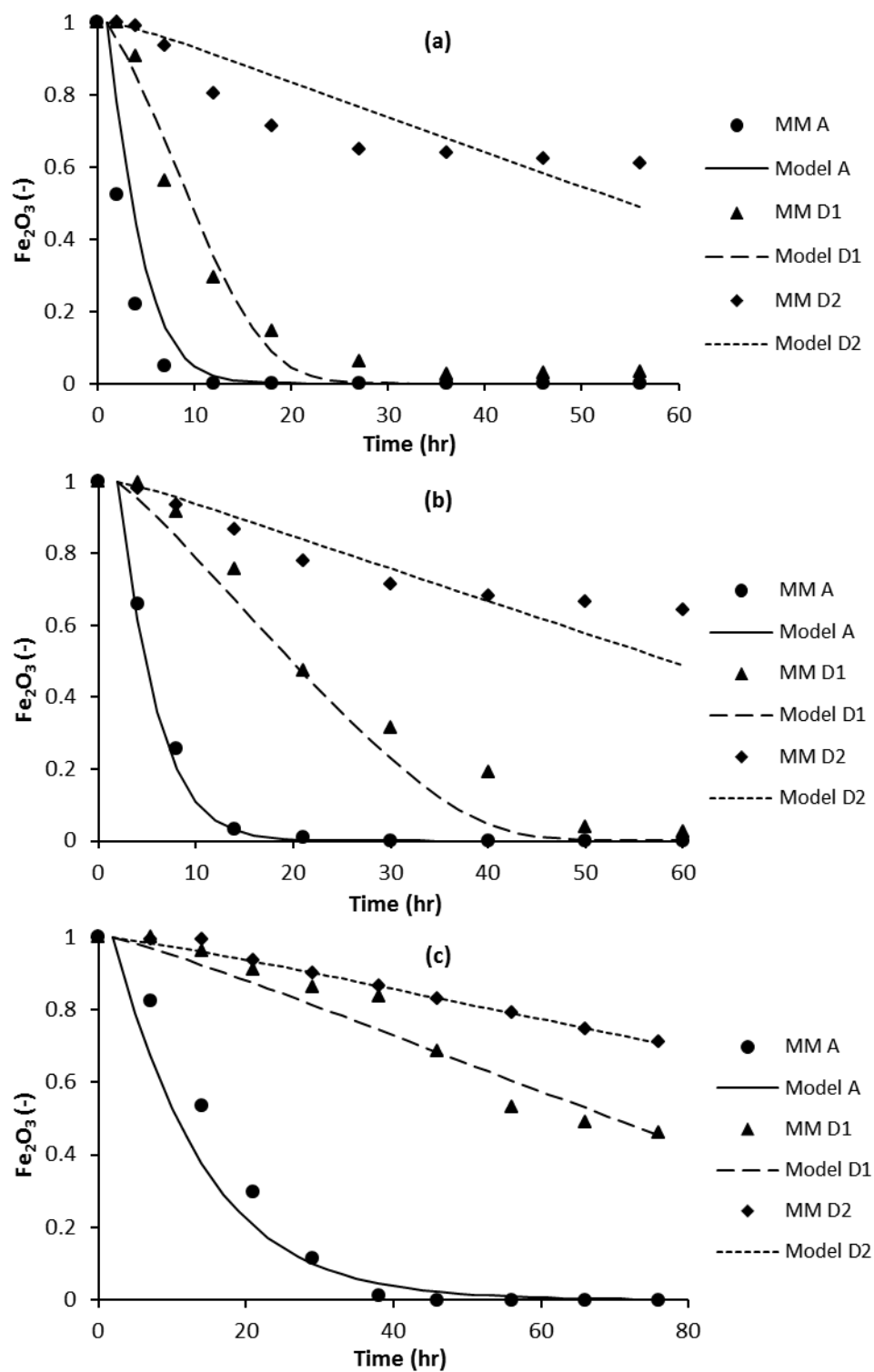


Figure S7. Fractions of Fe_2O_3 reacted determined from image analysis and calculated using the mass transfer model: (a) pH 5.0, (b) pH 6.0, (c) pH 7.0.

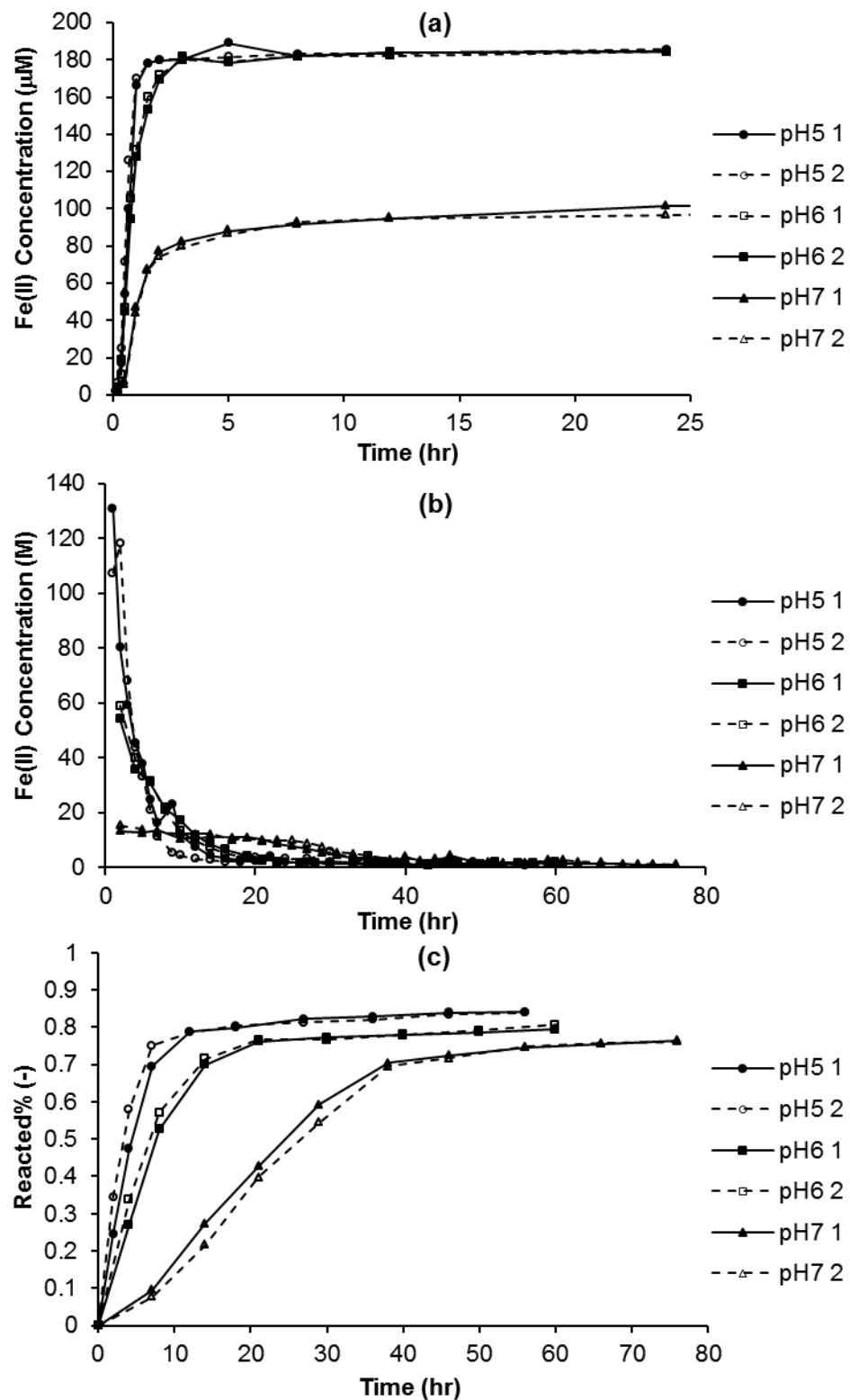


Figure S8. (a) Fe(II) concentration in batch experiments; (b) Fe(II) concentration in the micromodel effluent; (c) fraction of reacted hematite film determined from image analysis.

Table S1. Mass transfer coefficients calculated using the mass transfer model (values in parentheses indicate standard deviation from replicate experiments).

	pH 5	pH 6	pH 7
k_1 (hr ⁻¹)	355.27 (47.60)	123.41 (5.29)	64.32 (3.17)
k_2 (hr ⁻¹)	39.65 (2.13)	33.62 (0.71)	31.62 (0.71)

Equilibrium constant determined from standard state free energy of formation and reaction:

ΔG_f^0 values (kJ/mol) (Cornell and Schwertmann, 2003):

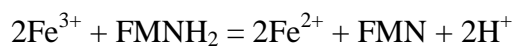
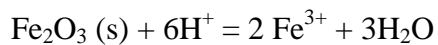
$$\text{Fe}_2\text{O}_3 (\text{s}) = -741.8$$

$$\text{Fe}^{2+} = -78.8$$

$$\text{H}_2\text{O} (\text{l}) = -238.2$$

$$\text{FMN} + 2\text{H}^+ + 2\text{e}^- = \text{FMNH}_2: E^0 = 0.197 \text{ V (Sober, 1968)}$$

$$\begin{aligned}\Delta G_f^0 &= \Delta G_{f,\text{FMNH}_2}^0 - \Delta G_{f,\text{FMN}}^0 = -nFE^0 = -2 \times 96.485(\text{kJ/V} \cdot \text{gram eq}) \times 0.197(\text{V}) \\ &= -38.015 \text{ kJ/mol}\end{aligned}$$



$$\Delta G_r^0 = -RT \ln K_{sp} = 38.015 + 3 \times (-238.2) + 2 \times (-78.8) - (-741.8) = -92.39 \text{ kJ/mol}$$

$$\log K_{sp} = 16.19 \text{ (Standard state free energy)}$$

$$\log K_{sp} = 19.96 \text{ (Experiment)}$$