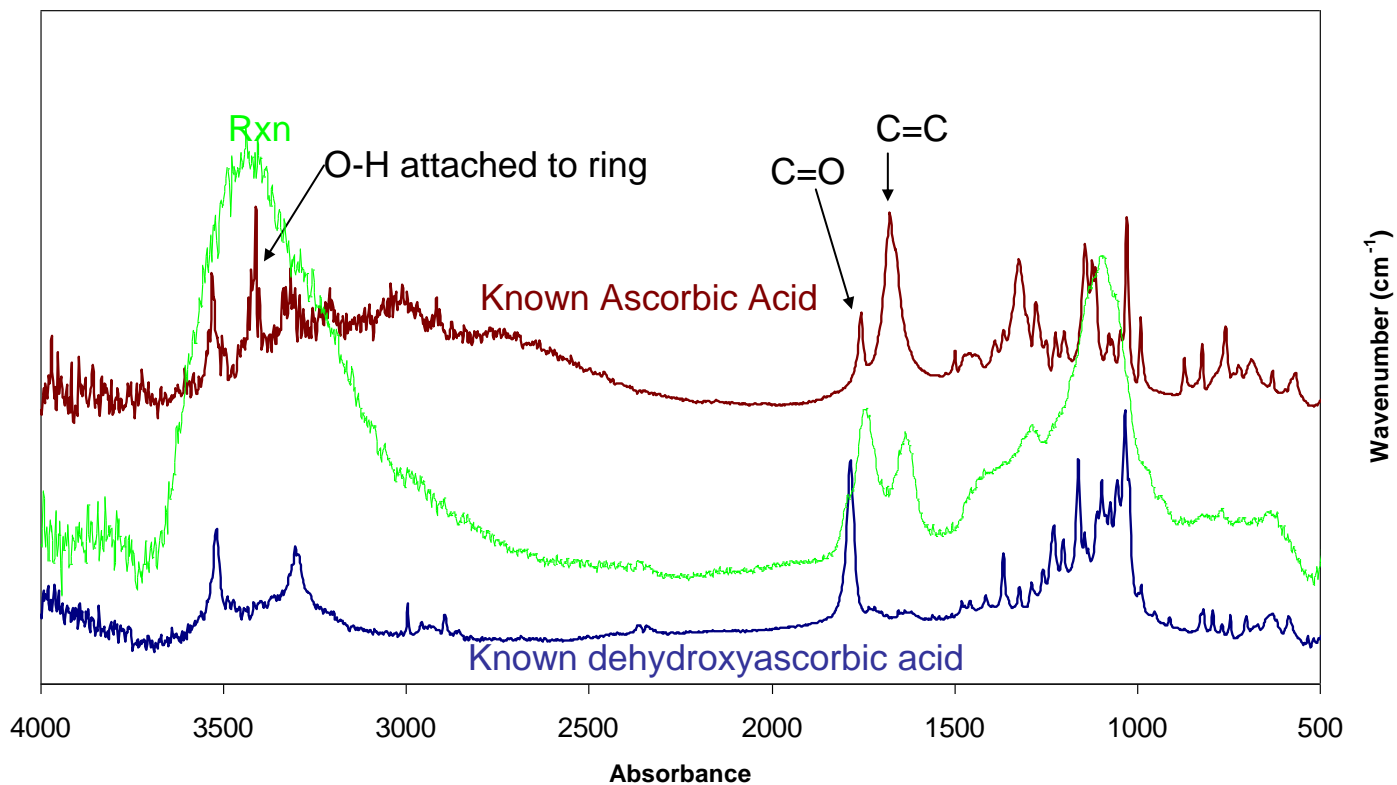
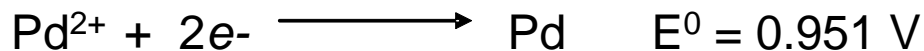
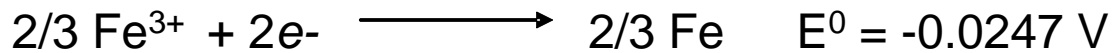
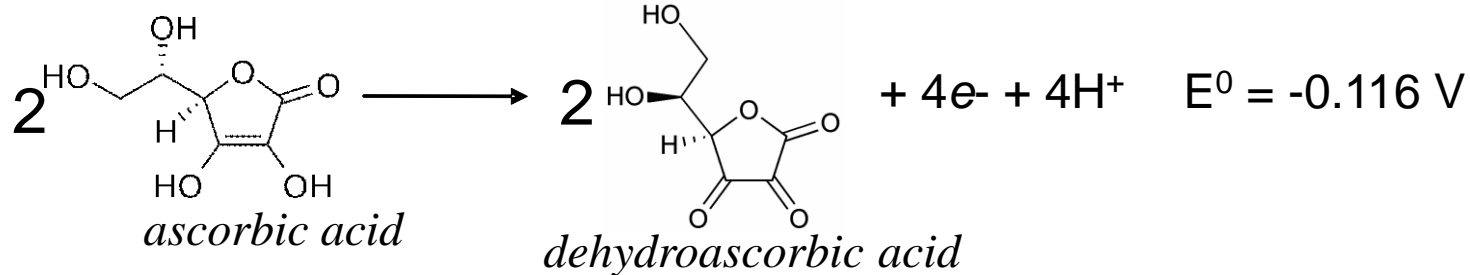


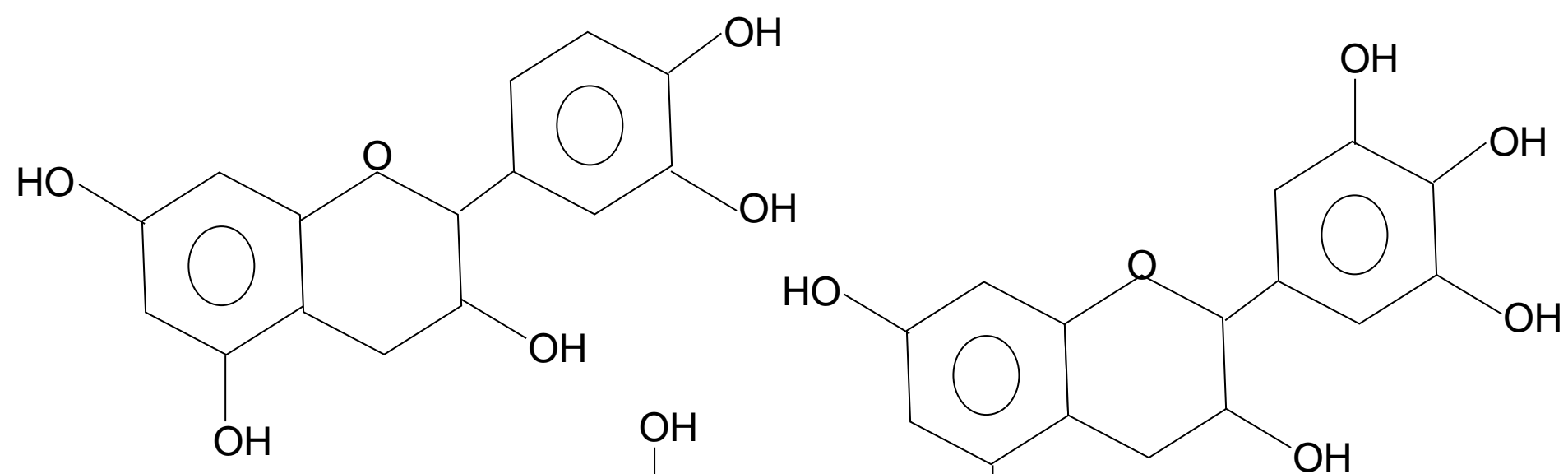
Fe and Fe/Pd nanoparticle synthesis in membrane domain using green chemistry

D. Bhattacharyya, S. Lewis, V. Smuleac, J. Wu, L. Zhao
University of Kentucky

KRCEE Meeting, Lexington KY
July 8, 2010

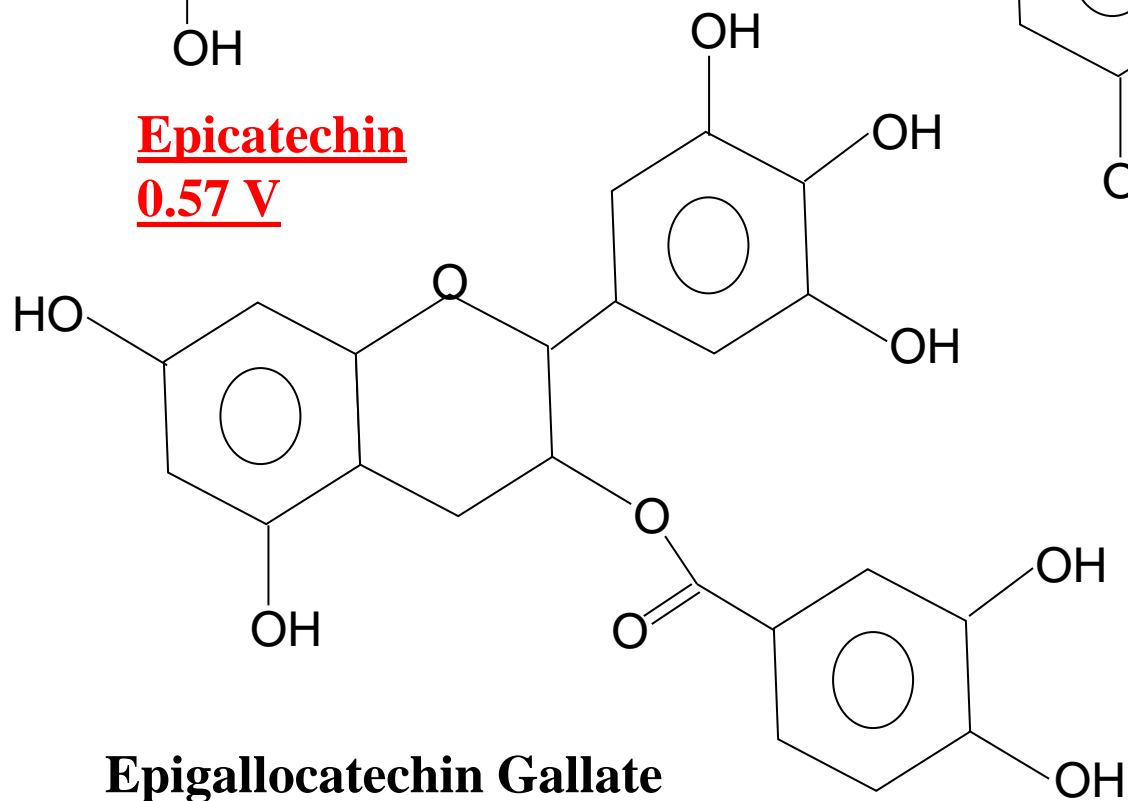


Fe/Pd reduction with ascorbic acid



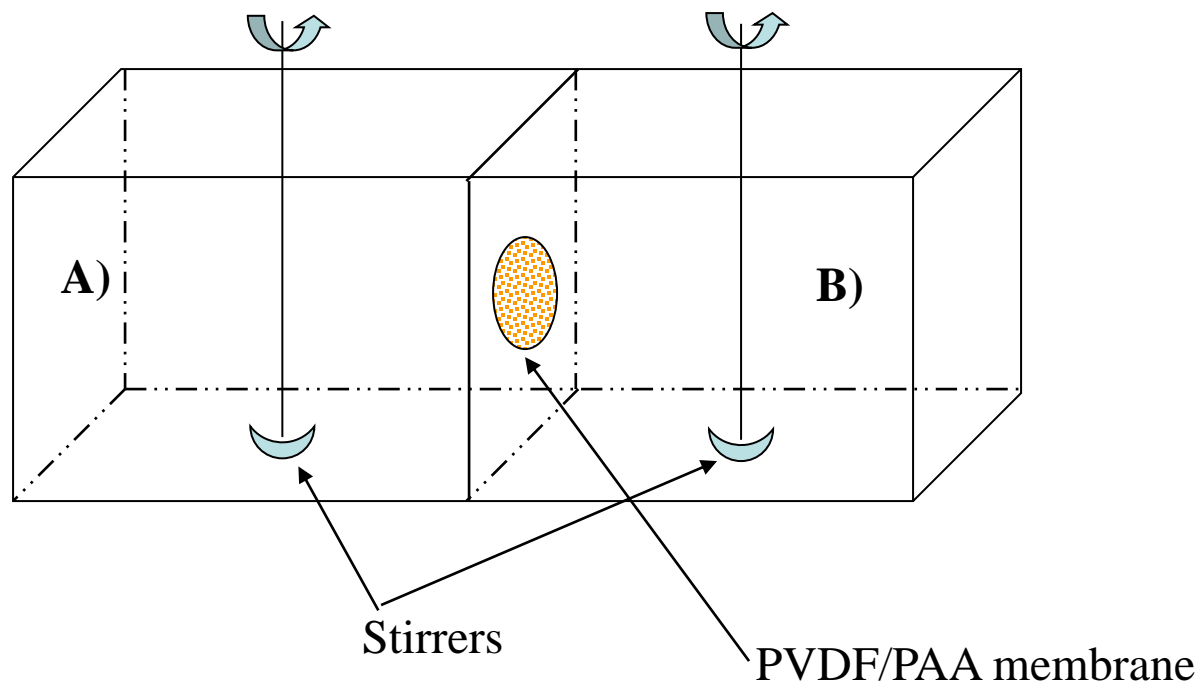
Epicatechin
0.57 V

Epigallocatechin



Epigallocatechin Gallate

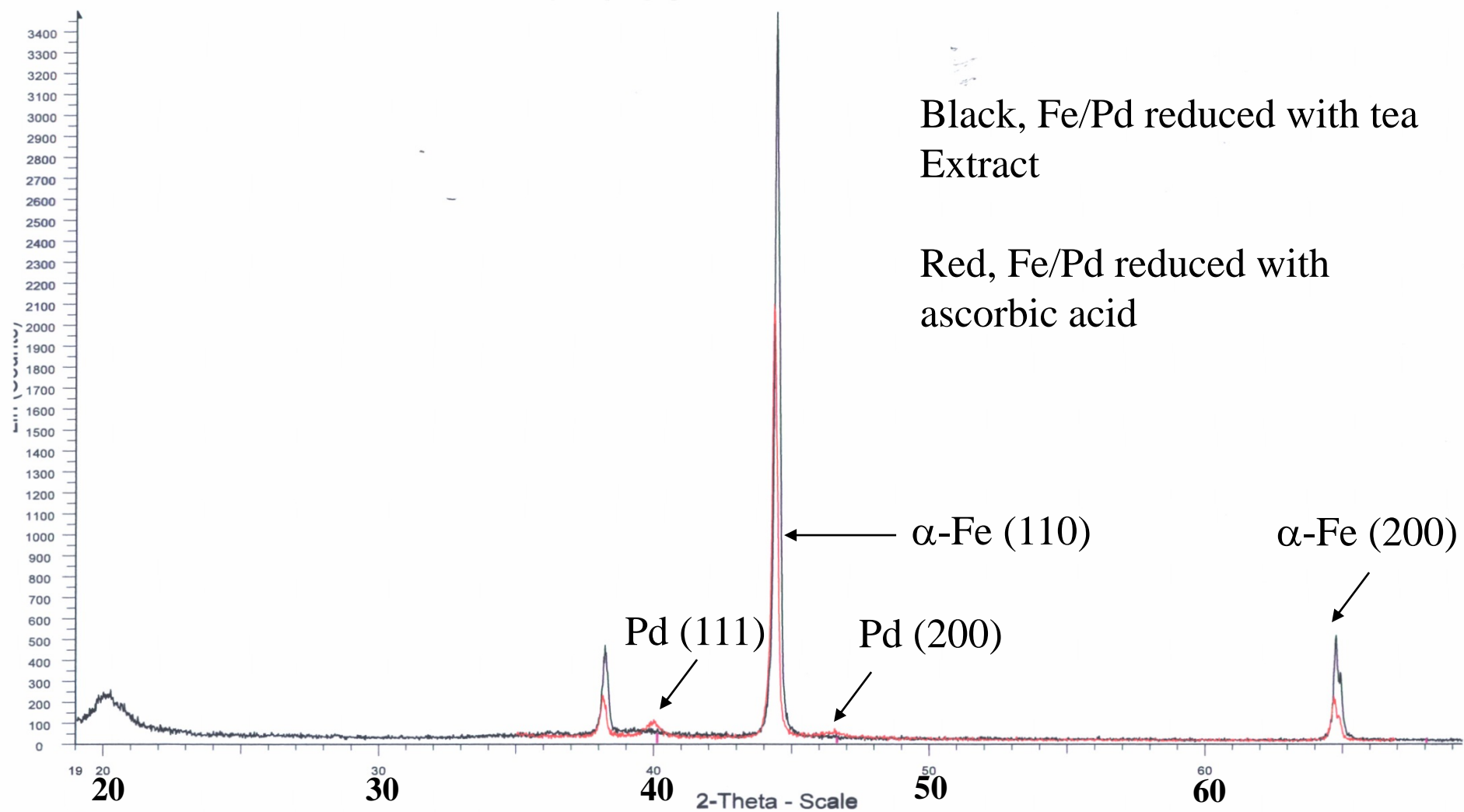
Chemical structures for the most abundant polyphenols in tea extract



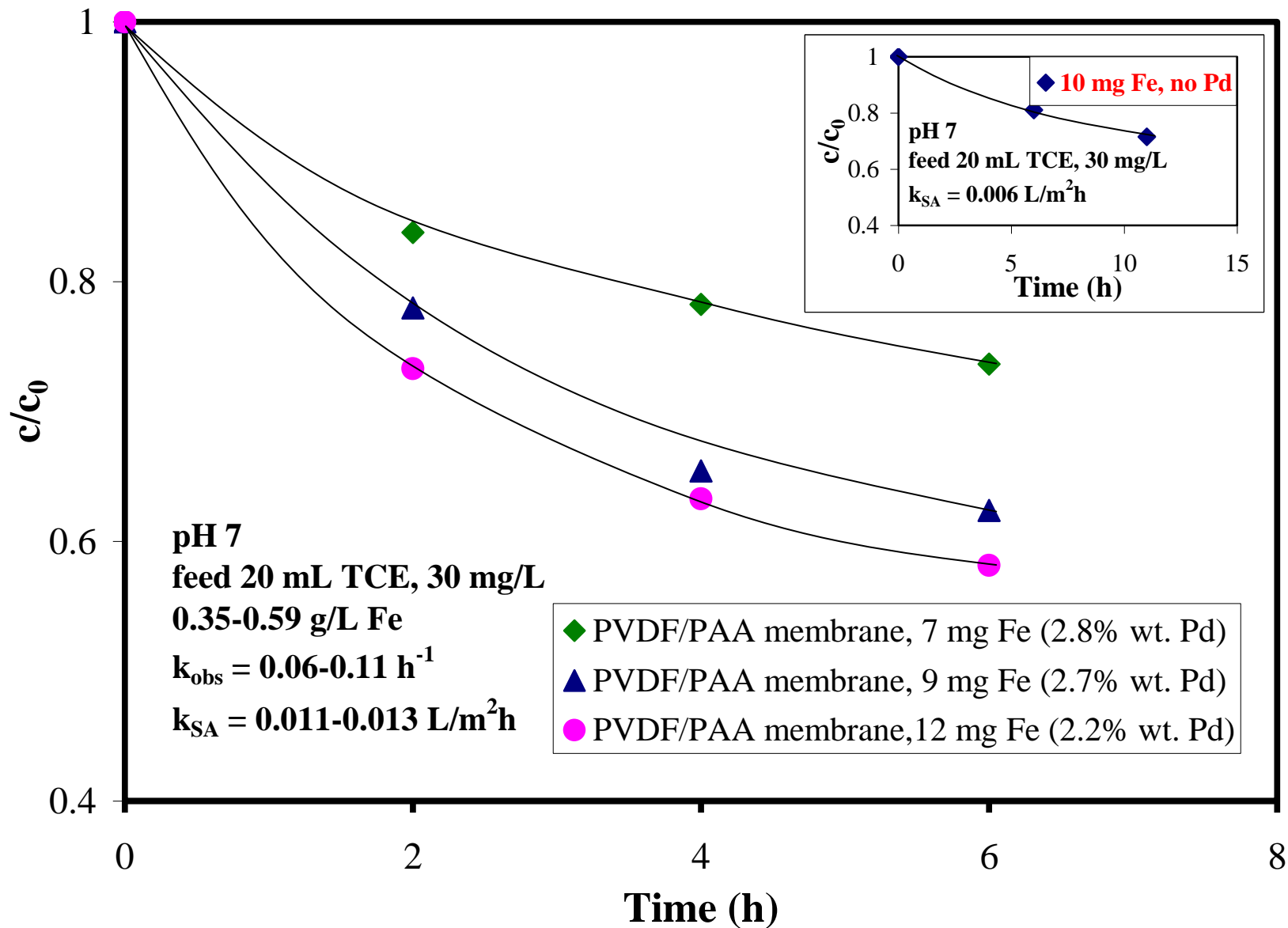
Step 1. A) FeCl_2
B) Tea extract/epicatechin

Step 2. A) K_2PdCl_4
B) Ascorbic Acid

Experimental setup for the membrane functionalization with Fe/Pd nanoparticles using diffusion cell



XRD spectra for Fe/Pd nanoparticles, reduced with ascorbic acid and tea extract

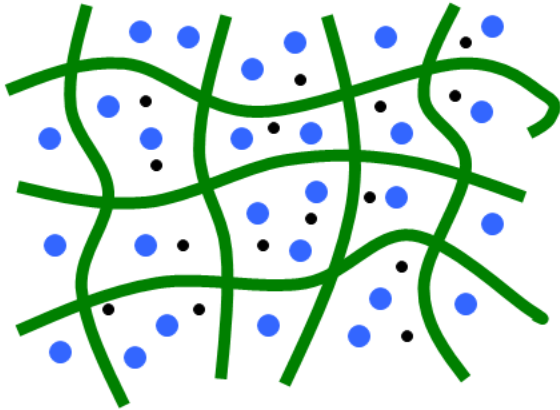


TCE degradation with Fe and Fe/Pd nanoparticles immobilized on PAA-coated PVDF membranes, synthesized using tea extract as a reducing agent

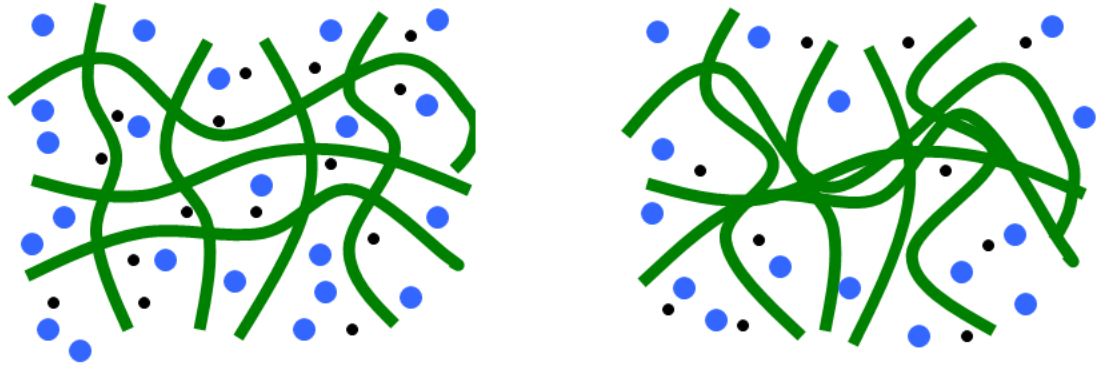
TCE dechlorination by Fe and Fe/Pd nanoparticles

Nanoparticle	Reducing agent	k_{SA} (L/m ² h)	Reference
Fe/Pd , 9 mg (1.7 wt%) immobilized on a membrane	NaBH ₄	0.114	S. Lewis, V. Smuleac, D. Bhattacharyya, Sep. Sci. Technol. 2009 , <i>44</i> , 3289-3311.
Fe/Pd , 12 mg (2.2 wt%), immobilized on a membrane	Tea extract	0.013	Our work
Fe , 10 mg, immobilized on a membrane	Tea extract	0.006	Our work
Fe , 43 mg, encapsulated in gel	NaBH ₄	0.006	Our work
Fe , CMC stabilized homogeneous phase	NaBH ₄	0.005	F. He, D. Zhao, Appl. Cat.:Environmen 2008 , <i>84</i> , 533-540.
Fe/Pd , (4.3 mg, 0.2 wt%), CMC stabilized homogeneous	NaBH ₄	0.062	F. He, D. Zhao, Appl. Cat.:Environmen 2008 , <i>84</i> , 533-540.
Fe/Pd , homogeneous phase	NaBH ₄	0.018	H. Lien, W. Zhang, Colloid Surf. A 2001 , <i>191</i> , 97-105.
Fe/Pd , on alginate bed (74 mg Fe/g bed, 0.03 wt% Pd)	NaBH ₄	0.010	Kim et al, J. Haz. Mat. 2010 , <i>176</i> , 1038-1043.
Fe/Pd , homogeneous phase	Ascorbic Acid	0.011	Our work
Fe , PMMA-coated homogeneous phase	KBH ₄	8 x 10 ⁻⁴	W. Wang, T. Li, J. Haz. Mat. 2010 , <i>173</i> , 724-730.

Hydrophilic, swelled



Hydrophobic, collapsed



Temperature Increase

● Water Molecule • Fe/ Metal — NIPAAm

Fe nanoparticle synthesis inside stimuli-responsive (t^0) hydrogel, to control the local environment