

EILERS GRADUATE STUDENT FELLOWSHIP FINAL REPORT

EILERS FELLOW:	Hanyu Ma
FACULTY ADVISOR:	Peter Burns and Chongzheng Na
REPORT PERIOD:	01/2017-05/2017
PROJECT TITLE:	Size Effect on Ruthenium Nanoparticle-Catalyzed Hydrogen Generation from Hydrazine Borane
CONNECTION TO ND ENERGY'S RESEARCH AREAS (CHECK ALL THAT APPLY):	<input checked="" type="checkbox"/> Energy Conversion and Efficiency <input type="checkbox"/> Sustainable and Secure Nuclear <input type="checkbox"/> Smart Storage and Distribution <input type="checkbox"/> Transformation Solar <input type="checkbox"/> Sustainable Bio/Fossil Fuels <input type="checkbox"/> Transformative Wind

MAJOR GOALS AND ACCOMPLISHMENTS:

List your major research goals and provide a brief description of your accomplishments (1-2 sentences). Indicate the percentage completed for each goal. Please use a separate sheet to share additional details, technical results, charts, and graphics.

MAJOR RESEARCH GOALS	ACTUAL PERFORMANCE AND ACCOMPLISHMENTS	% OF GOAL COMPLETED
Synthesis of size-controlled nanoparticles	Successfully synthesized Ru nanoparticles from 2.0 to 3.8 nm and Pd nanoparticles from 2.0 to 9.31 nm	100%
Hydrolysis of hydrazine borane to generate hydrogen with the nanoparticles.	High hydrogen generation rate is observed with Ru nanoparticles from 5 to 40 °C.	100%
Identify size effect and compensation effect.	The activation energy is insensitive to the size of the nanoparticles and no compensation effect is observed.	0%

RESEARCH OUTPUT:

Please provide detailed information below regarding any output resulting from your research project.

CATEGORY	INFORMATION
EXTERNAL PROPOSALS	(Sponsor, Project Title, PIs, Submission Date, Proposal Amount)
EXTERNAL AWARDS	(Sponsor, Project Title, PIs, Award Date, Award Amount)
JOURNAL ARTICLES	(Journal Name, Title, Authors, Submission Date, Publication Date, Volume #, Page #s)
BOOKS AND CHAPTERS	(Book Title, Chapter Title, Authors, Submission Date, Publication Date, Volume #, Page #s)
PUBLIC PRESENTATIONS, SEMINARS, LECTURES	(Event, Presentation Title, Presentation Date, Location)
AWARDS, PRIZES, RECOGNITIONS	(Purpose, Title, Date Received)
INTERNAL COLLABORATIONS FOSTERED	(Collaborator Name, Organization, Purpose of Affiliation)
EXTERNAL COLLABORATIONS FOSTERED	(Collaborator Name, Organization, Purpose of Affiliation)
WEBSITE(S) FEATURING RESEARCH PROJECT	(URL)

OTHER PRODUCTS AND SERVICES (e.g., media reports, databases, software, models, curricula, instruments, education programs, outreach for ND Energy and other groups)

(Please describe each item in detail)

MAJOR GOALS AND ACCOMPLISHMENTS (Additional Details, Technical Results, Charts and Graphics)

Completed goal: Synthesis of size-controlled nanoparticles

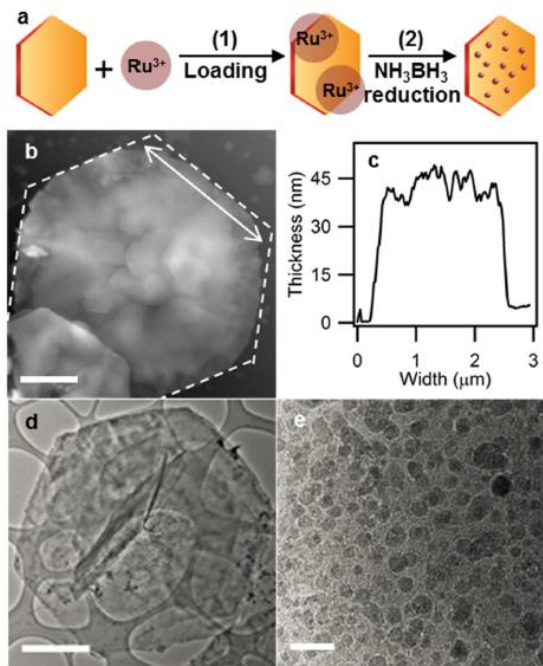


Figure 1. Preparation and morphology of Ru nanoparticles supported on layered double oxide (LDO) nanodiscs. (a) Major steps in preparation. (b) Atomic force micrograph (AFM) of LDO nanodiscs. (c) AFM profile (location marked by the double-headed line in b) showing the thickness of LDO nanodiscs. (d) Transmission electron micrograph (TEM) of LDO-Ru-FCC. (e) TEM of Ru nanoparticles on LDO. Scale bars: *b* and *d*, 1 μm; *e*, 10 nm.

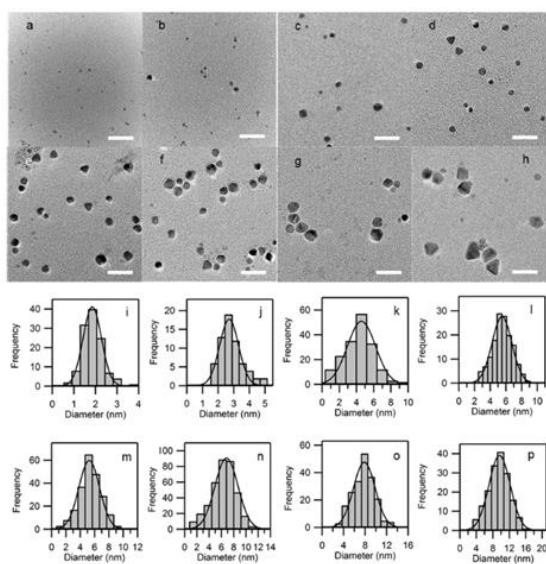


Figure 2. Transmission electron micrographs of poly(N-vinyl-2-pyrrolidone) stabilized palladium nanoparticles: (a) 2.02(±0.40), (b) 2.84(±0.54), (c) 4.56(±1.22), (d) 5.41(±1.29), (e) 5.70(±1.42), (f) 6.62(±1.69), (g) 8.23(±1.80) and (h) 9.31(±2.56) nm and their corresponding histograms: (i) - (p). Scale bars: 20 nm.