







ندوة عن الهيدروجين ودوره في عملية تحول الطاقة

تطوير متراكبات مواد نانوية عالية السعة لتخزين الهيدروجين قائمة على عنصر
المغنيسيوم في تشغيل المركبات التي تعمل بخلايا الوقود

أستاذ دكتور مهندس / محمد شريف الإسكندراني
باحث علمي رئيسي

برنامج تكنولوجيا النانو وتطبيقاتها، مركز أبحاث الطاقة والبناء،
معهد الكويت للأبحاث العلمية، دولة الكويت



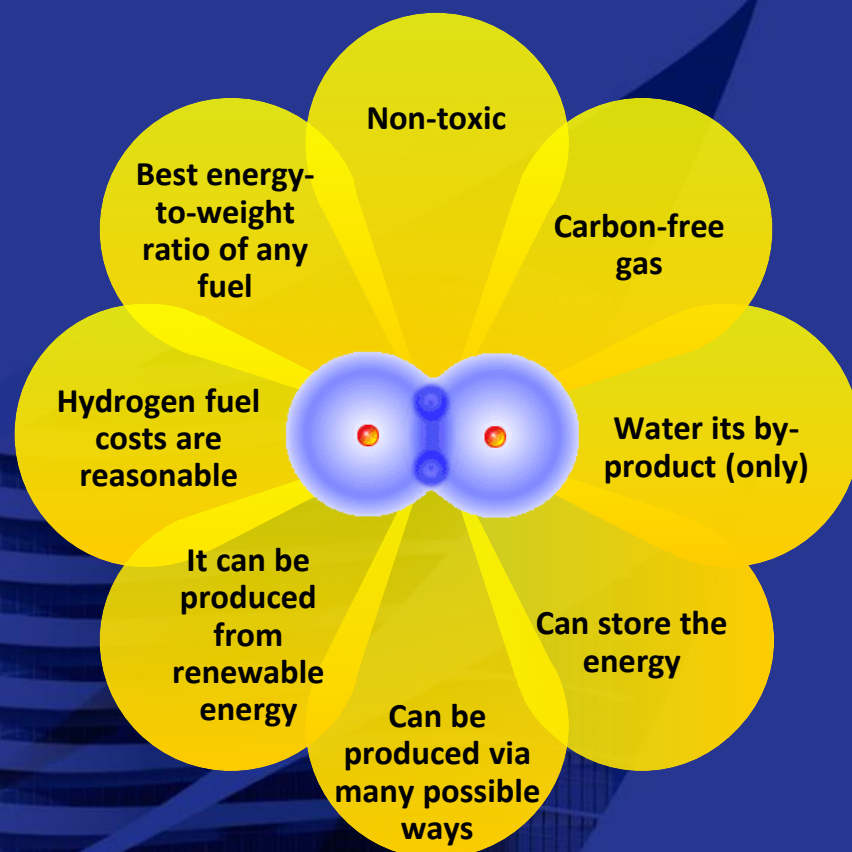
الطاقة

مستدامة

تقليدية

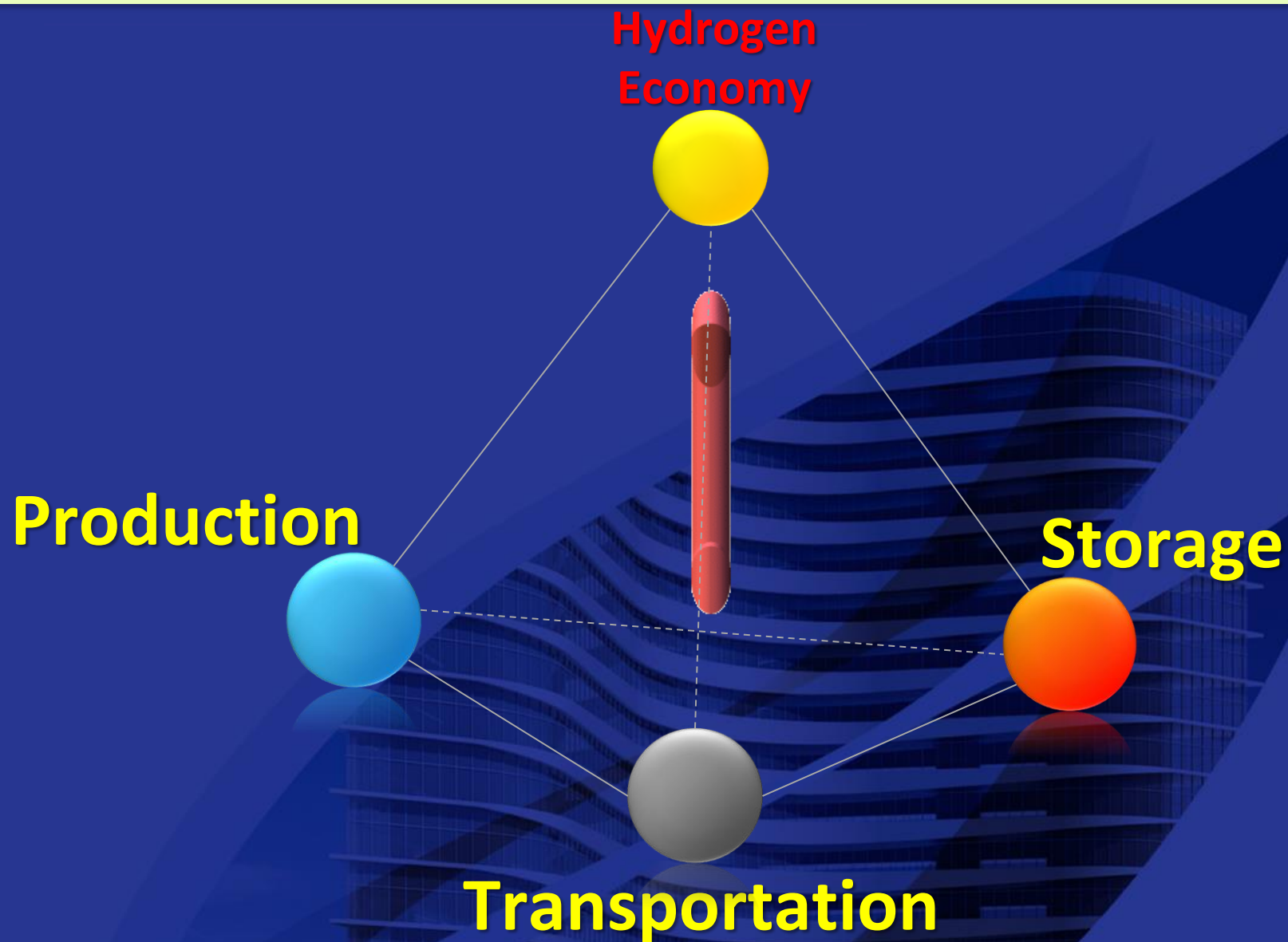
Hydrogen has been considered to be a source of alternative energy for replacing the traditional fossil fuel-based energy in many applications.

It is the only energy carrier that can be produced easily in large amounts and in an appropriate time scale.





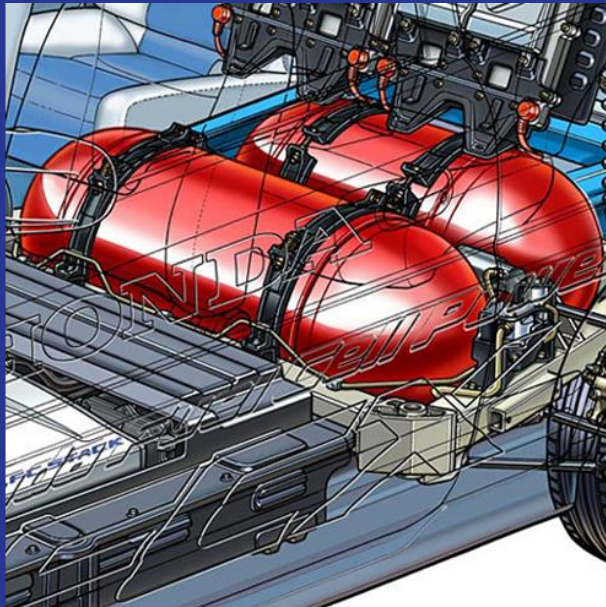
Hydrogen Economy





Traditional Ways for Hydrogen Storage

Gaseous Storage Method



Liquid Storage Method

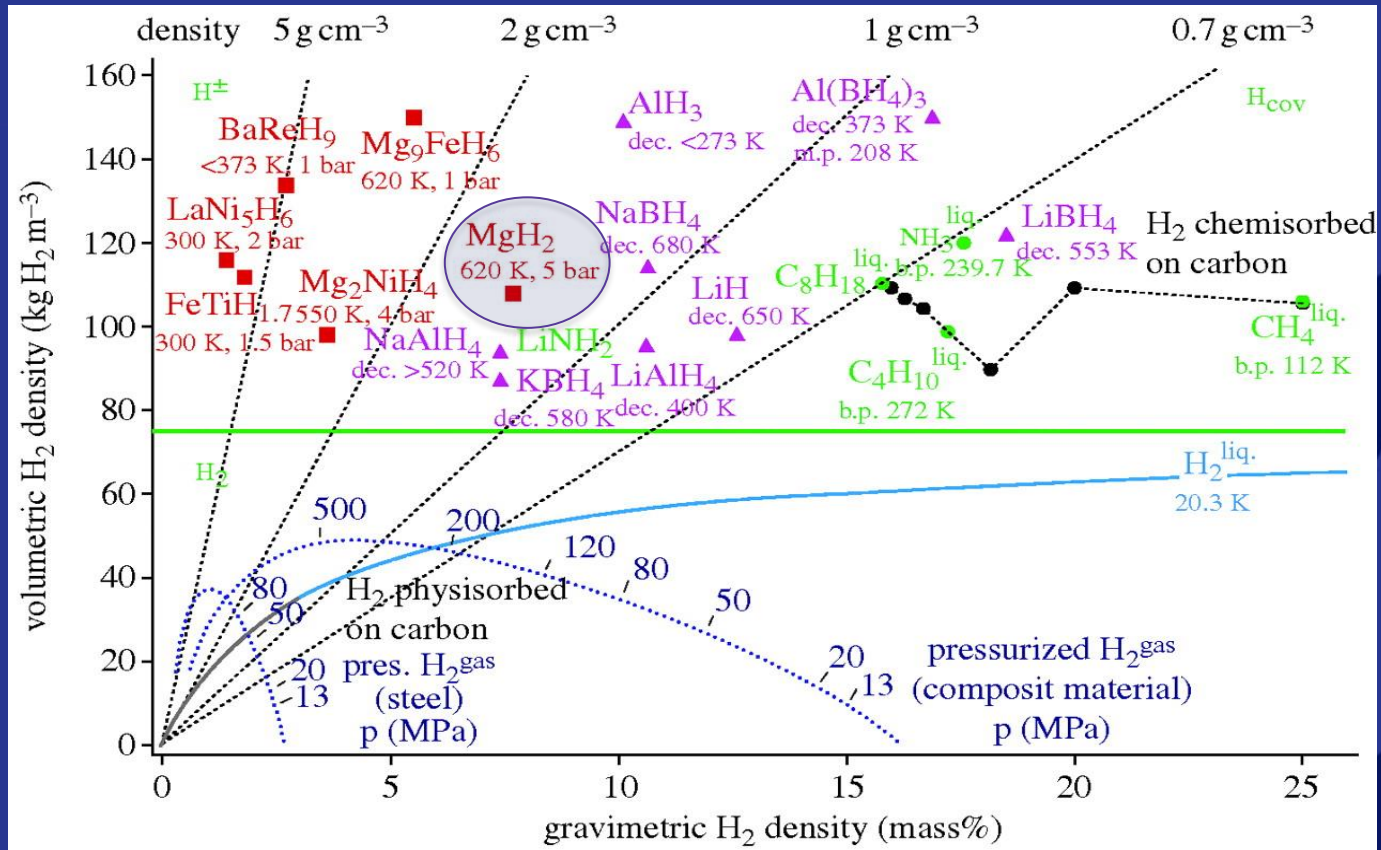




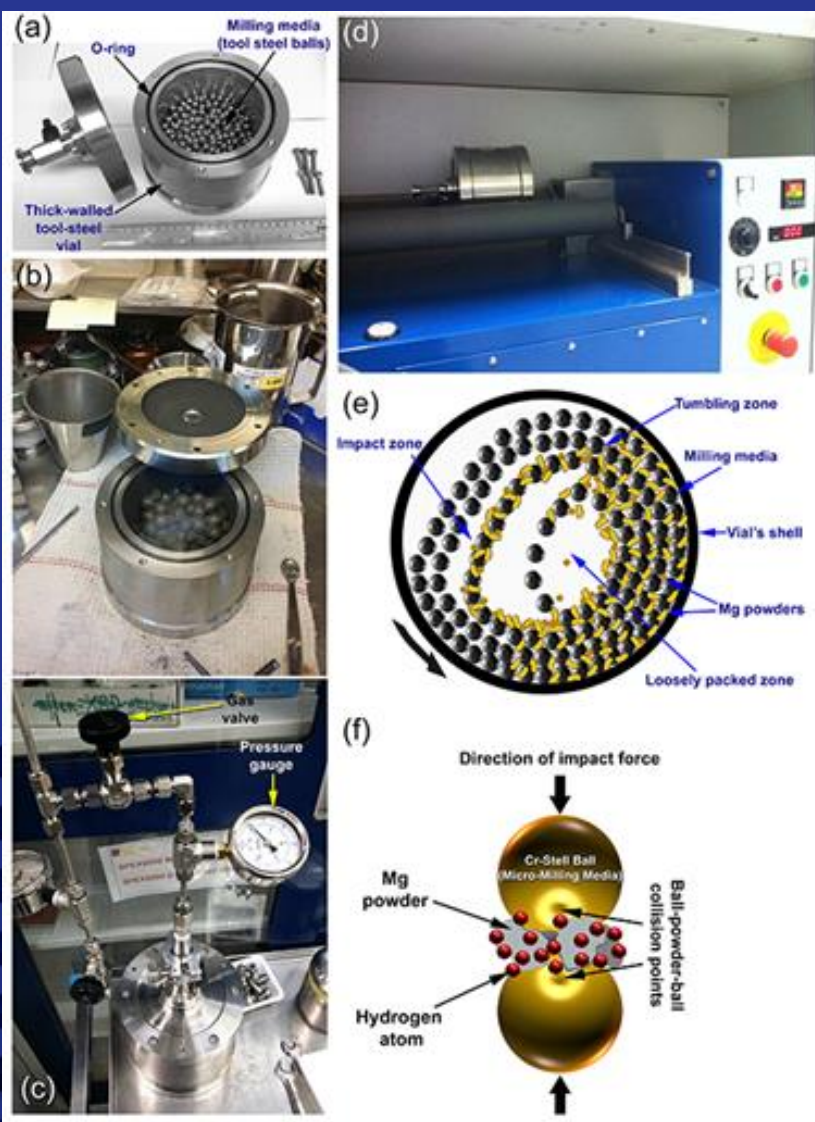
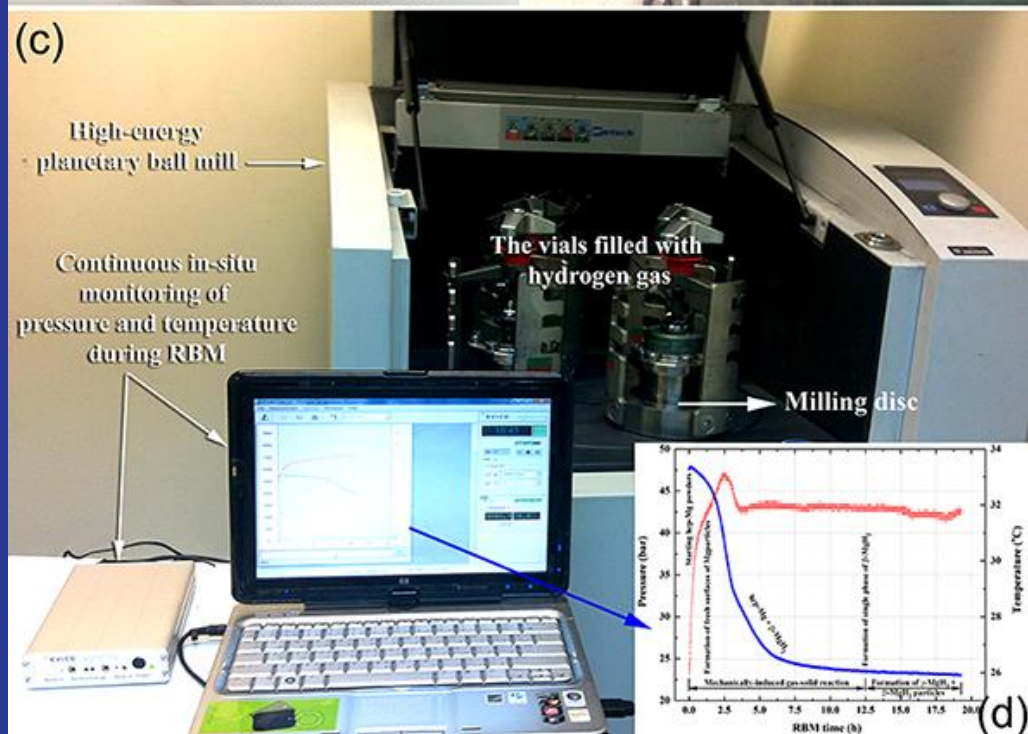
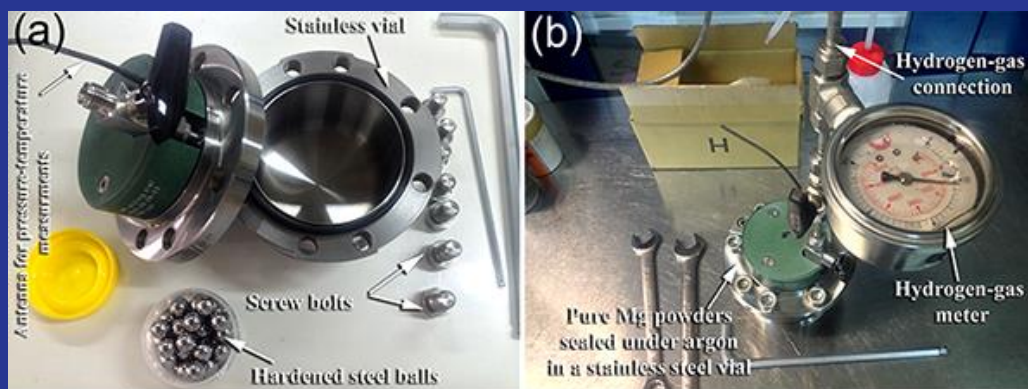
Table 1. Hydrogen Storage Technology Comparison

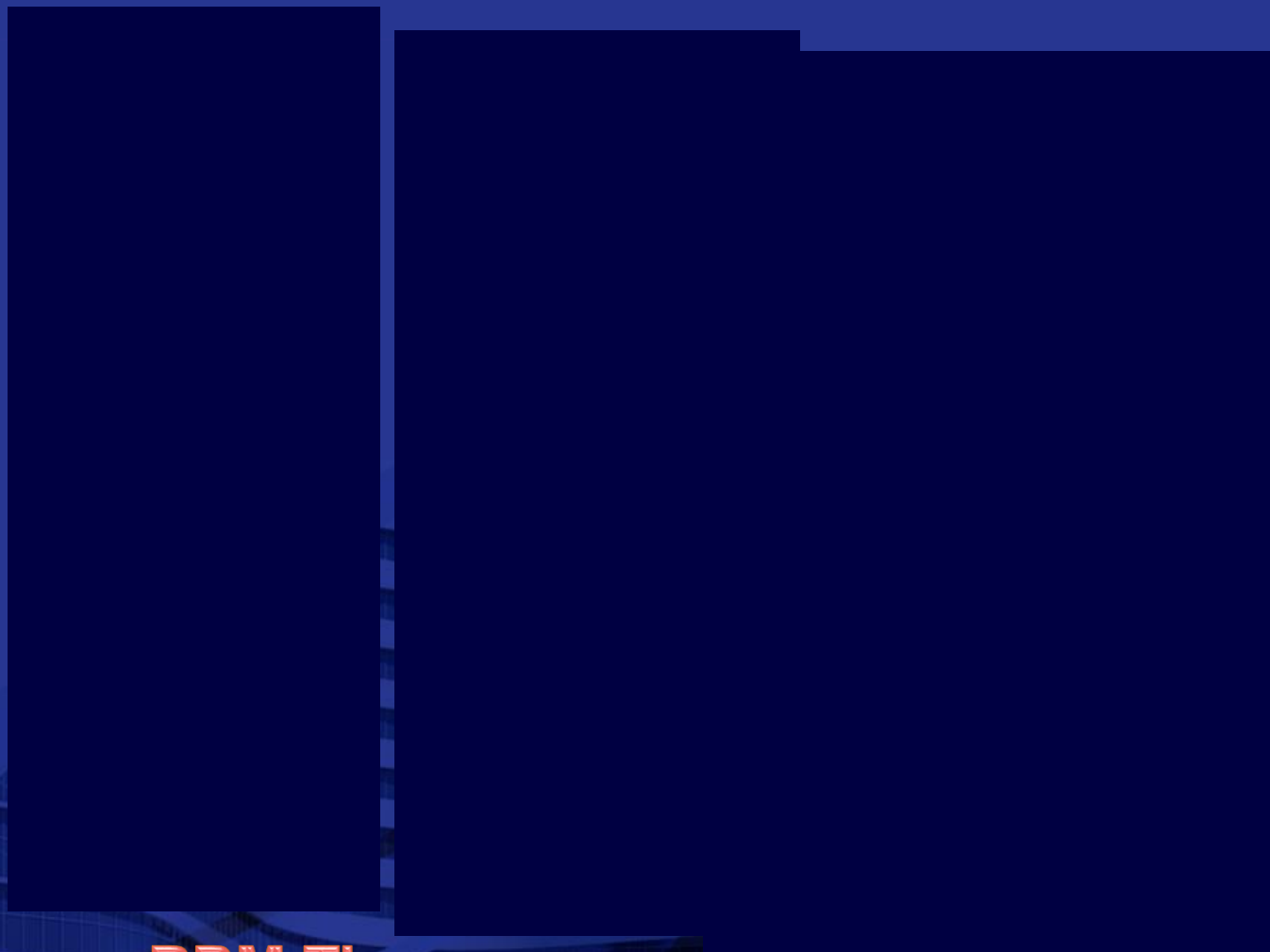
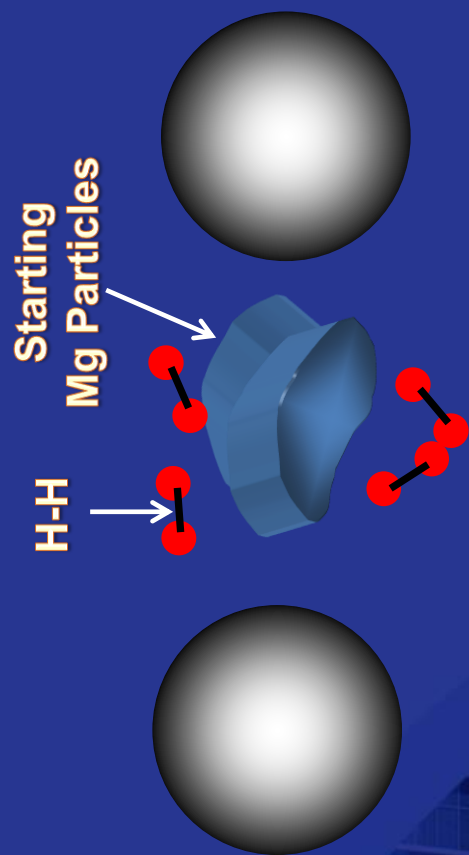
	Compressed-H ₂	Liquid-H ₂	MgH ₂
Pressure (MPa)	70	1	1
Gravimetric Energy Density (wt%)	5.7	7.5	7.6
Volumetric Energy Density (MJ/L)	4.9	6.4	13.2
Temperature (°C)	Ambient	-253	300

The lack of a **safety, convenient and cost-effective hydrogen storage system** makes it difficult to introduce hydrogen on a wide scale.



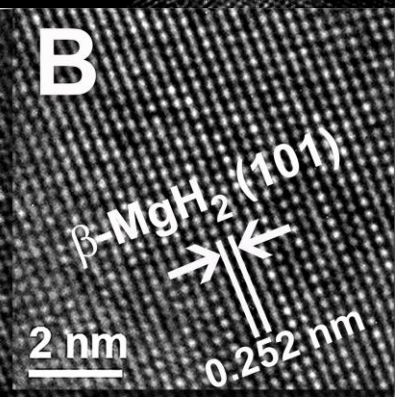
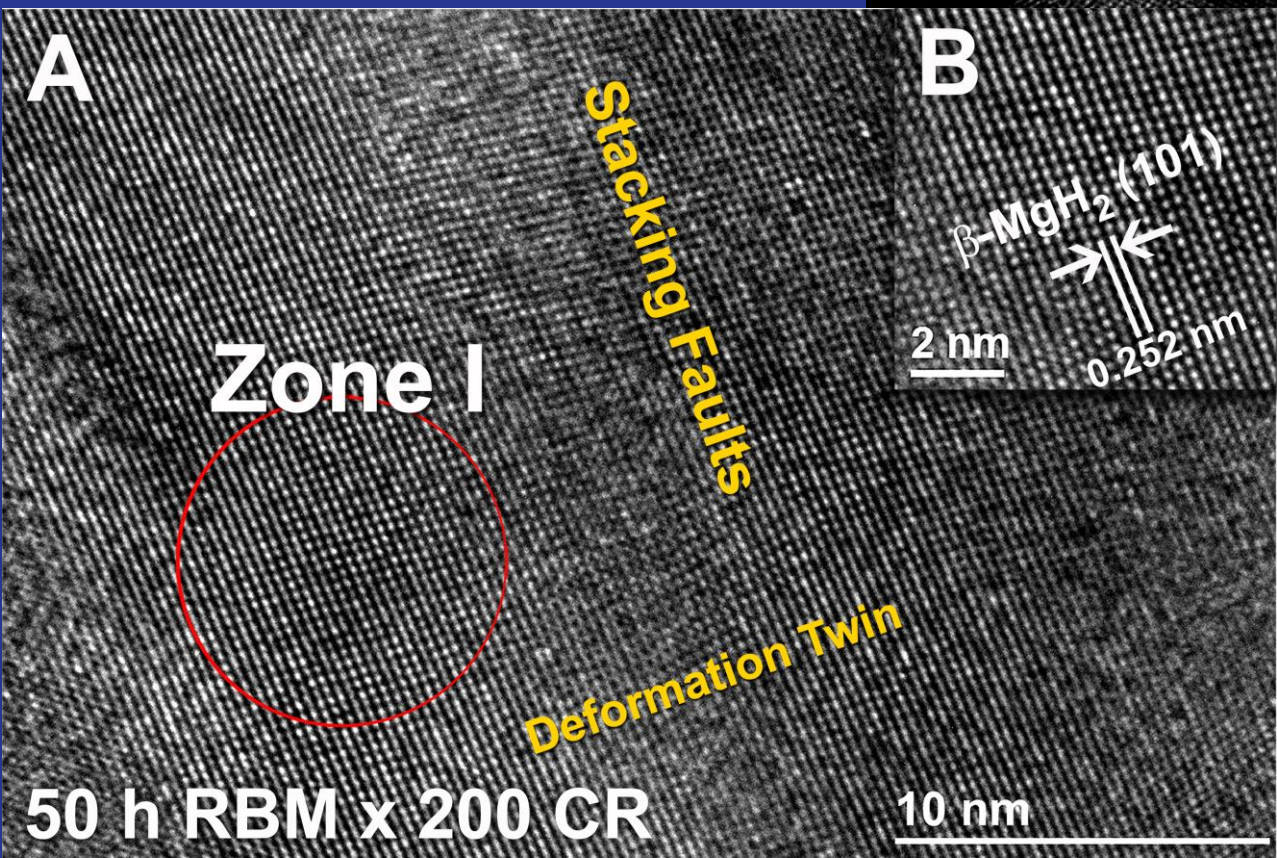
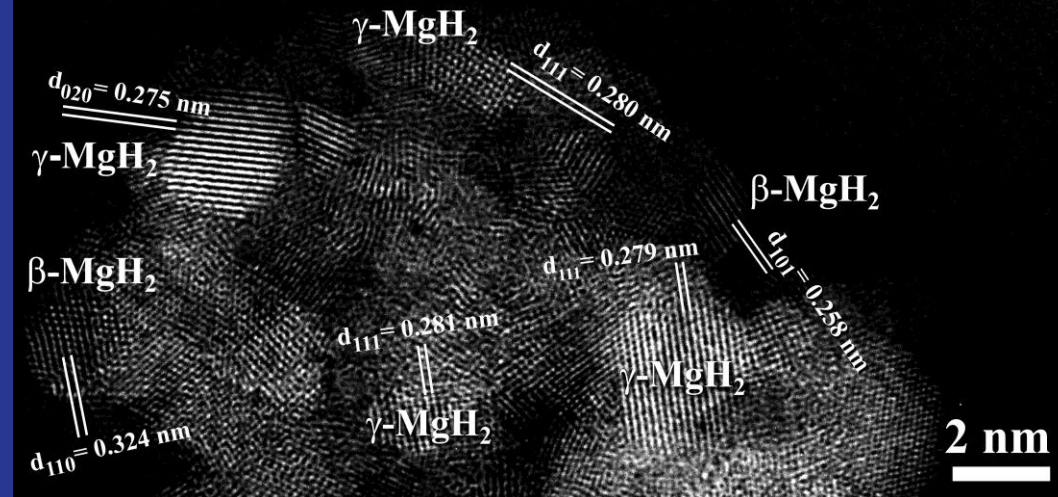
Volumetric and gravimetric hydrogen storage densities of different hydrogen storage methods. Metal hydrides are represented with squares and complex hydrides with triangles. BaReH₉ has the highest known hydrogen to metal ratio, Mg₂FeH₆ has the highest known volumetric H₂ density, LiBH₄ has the highest gravimetric density. Reported values for hydrides are excluding tank weight

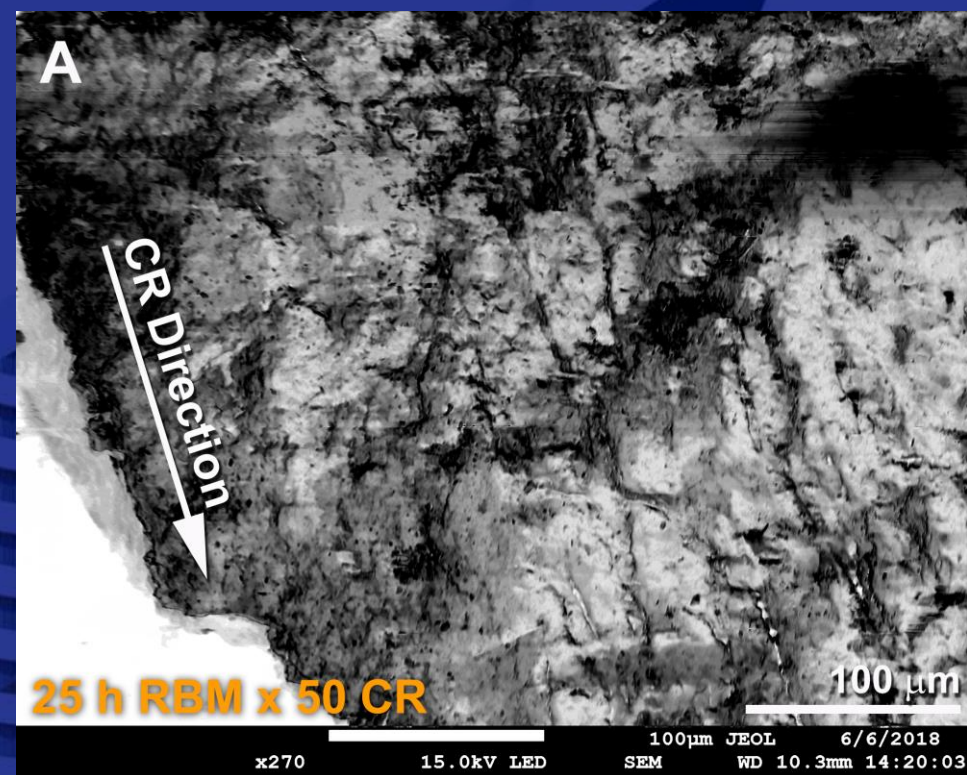
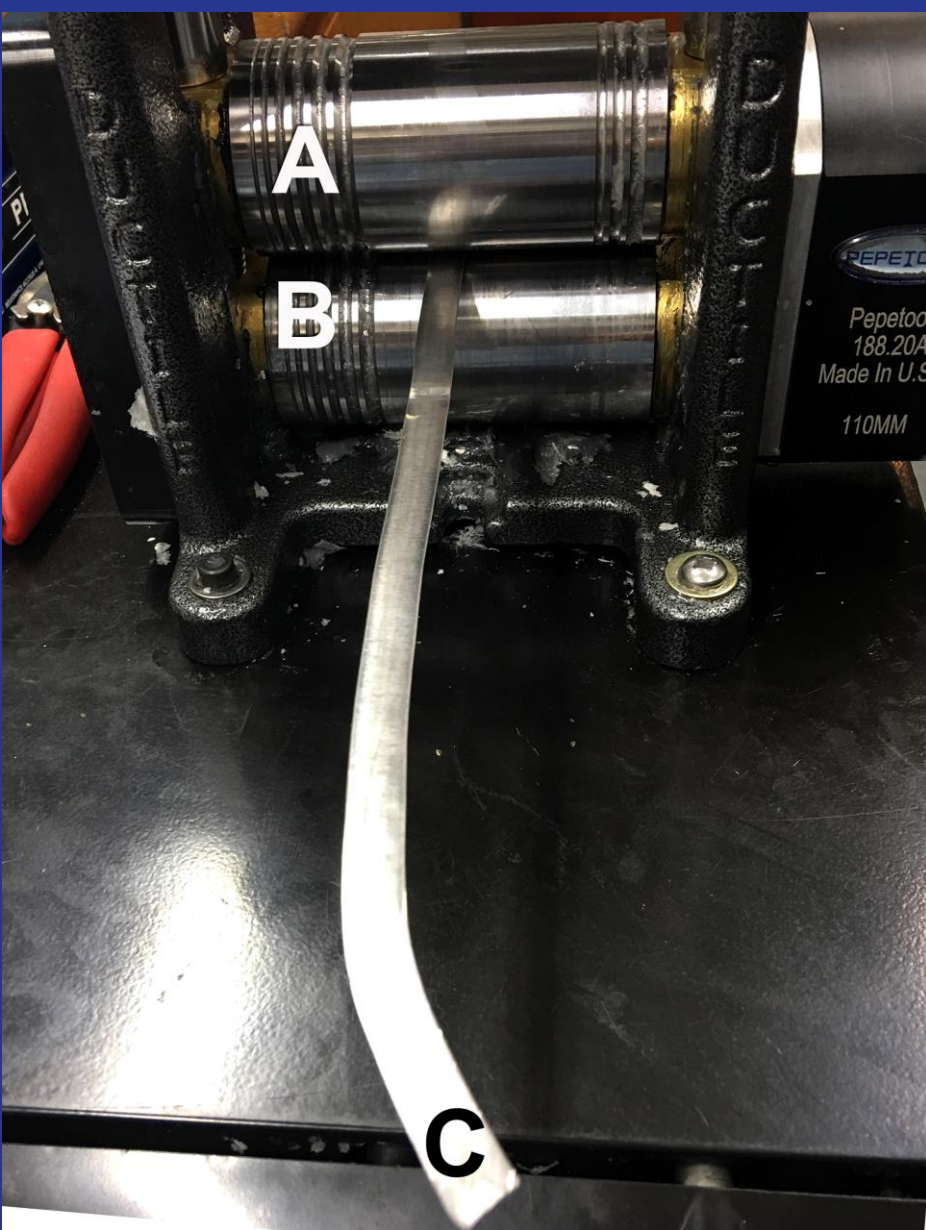




RBM Time







A**200 CR x 50 h HEBM****B** $a_0(111) = 0.44361 \text{ nm}$ $d\text{-fcc}_{(111)} = 0.2561 \text{ nm}$

5 nm

10 nm

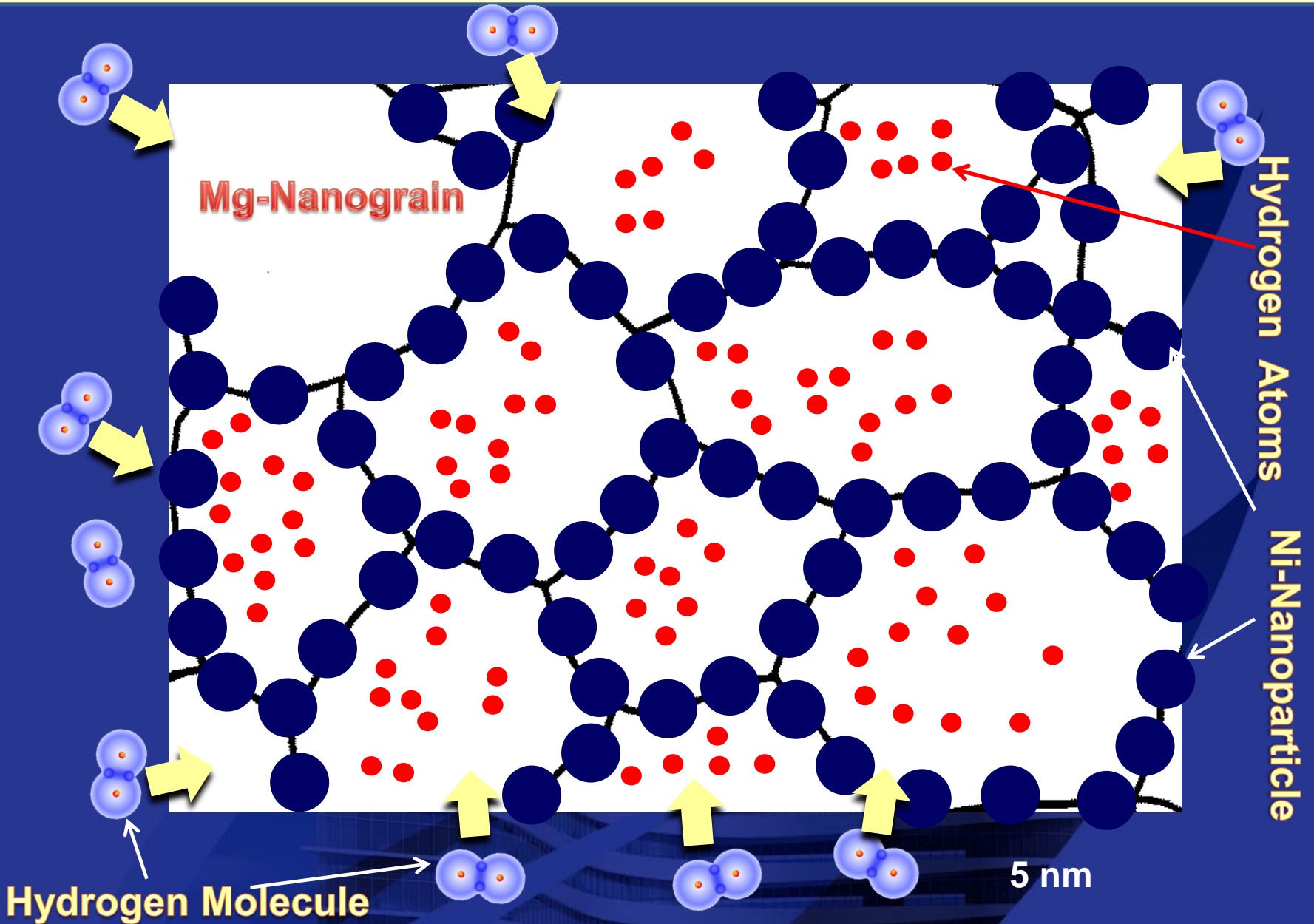
Zone I

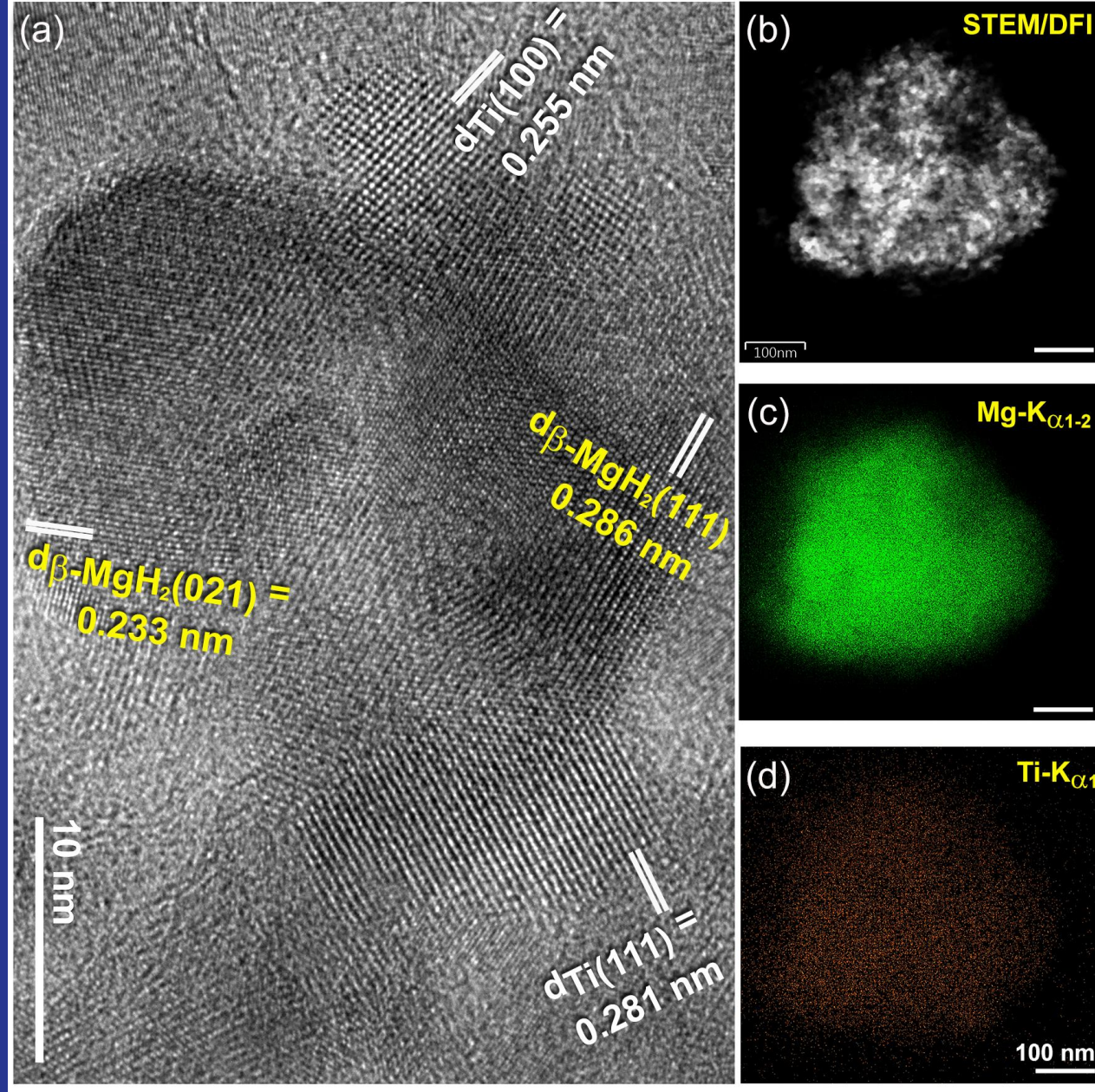
	-440	
-422		-24-2
-404	-220	04-4
-202		02-2
-2-24	000	22-4
0-44	2-20	40-4
2-42	4-2-2	
4-40		

C

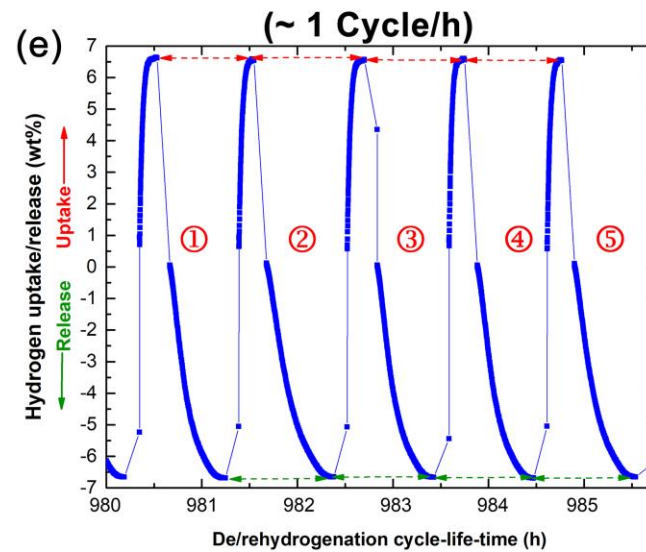
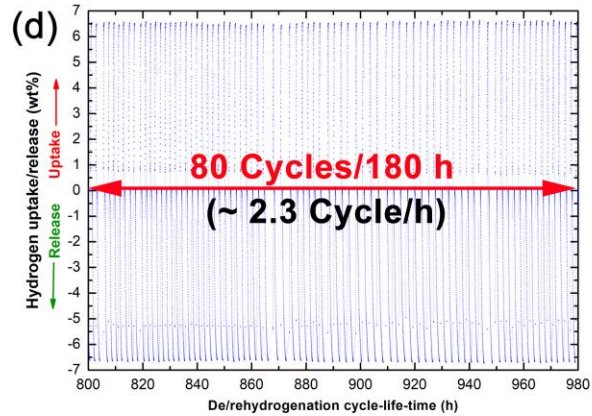
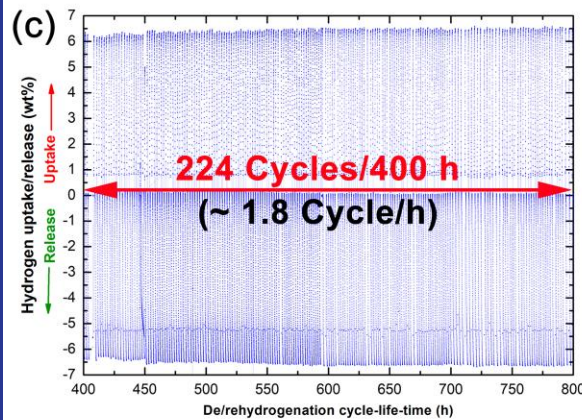
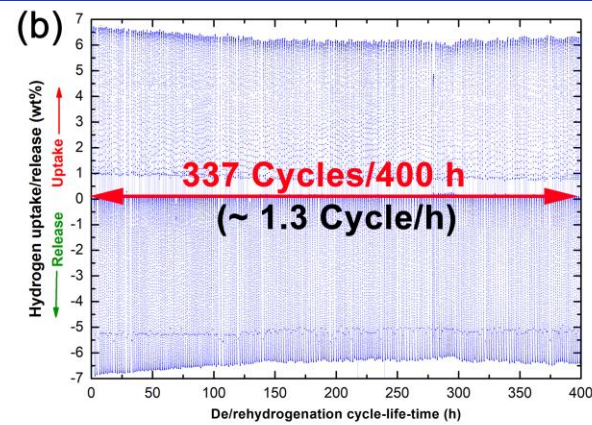
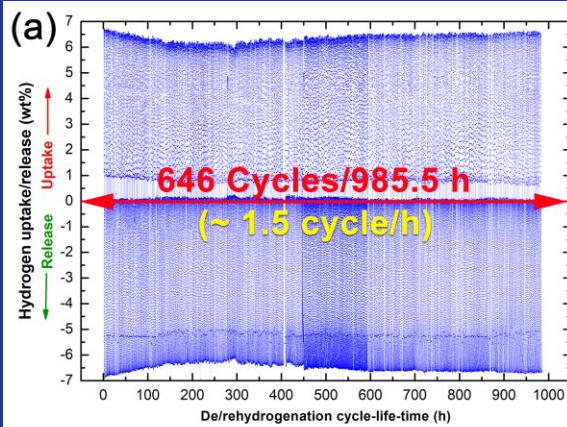


Catalytic Agents for Improving the Hydrogenation/dehydrogenation Kinetics of MgH_2

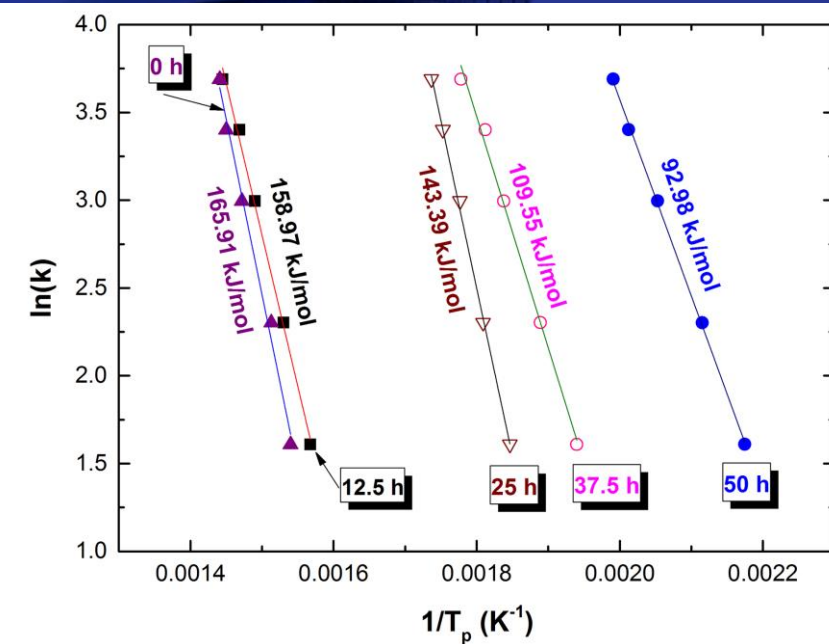
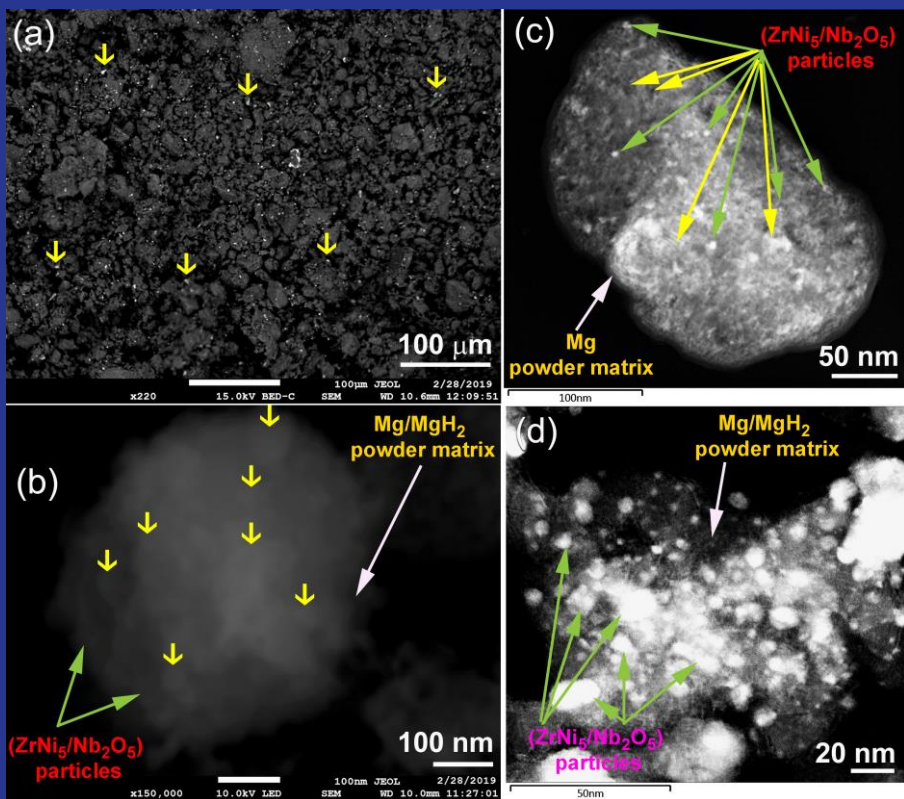
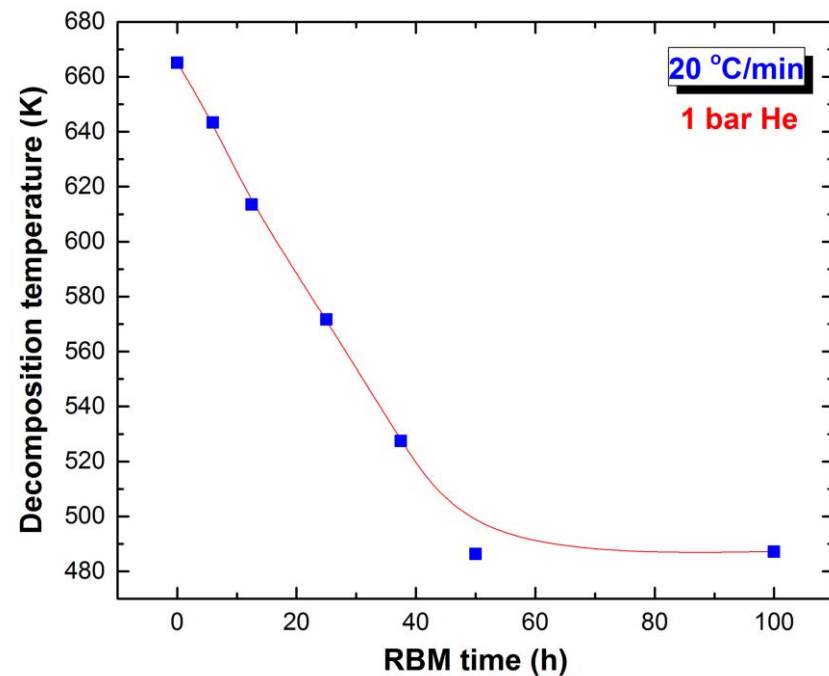
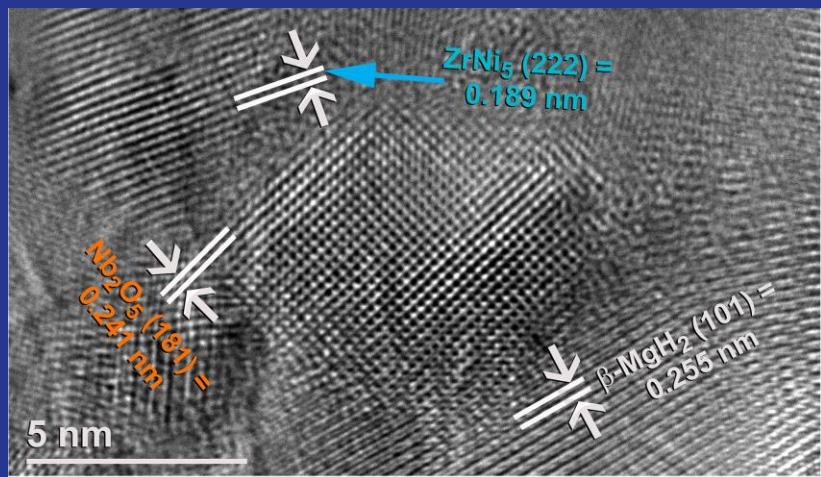


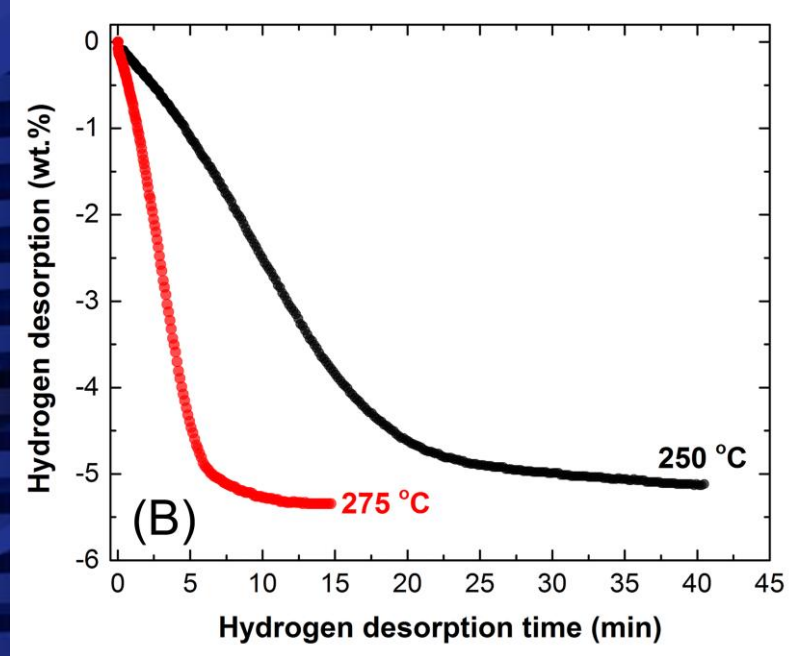
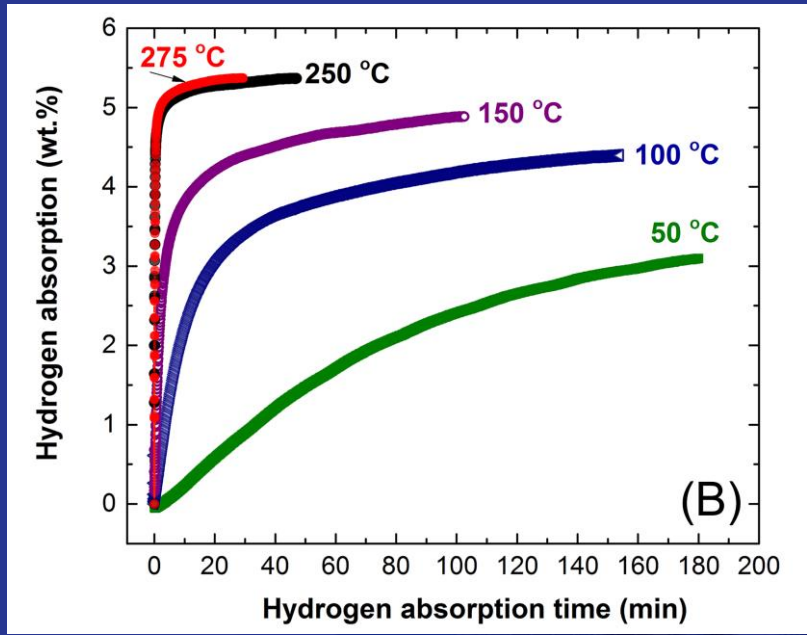
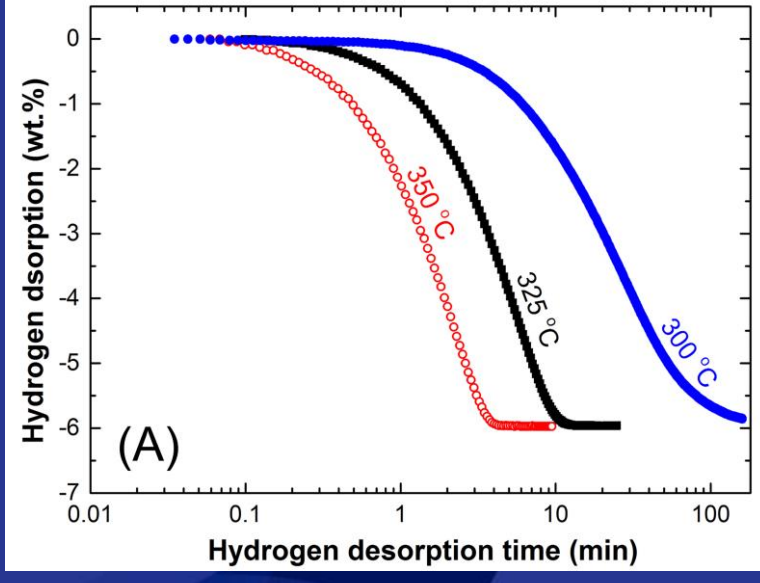
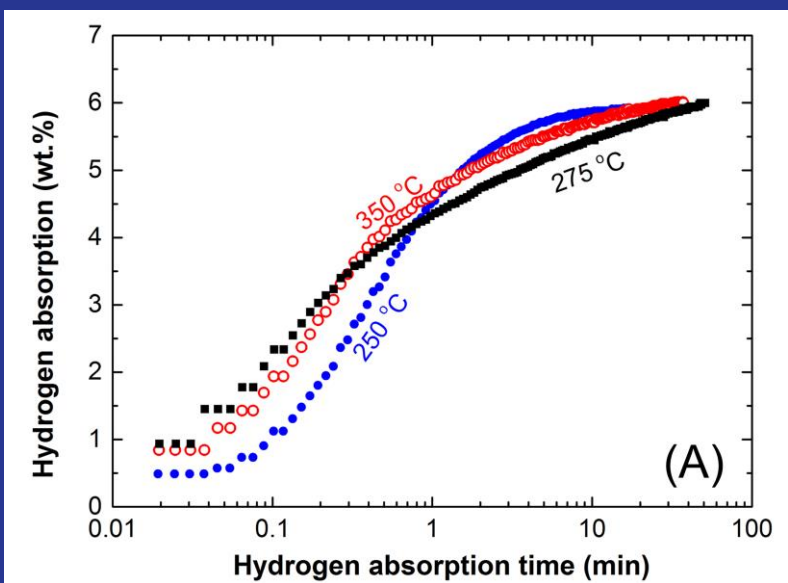


Mohamed Sherif El-Eskandarany, Abdullah Alkandary, Fahad Aldakheel, Mariam Al-Saidi, Fahad Al-Ajmi and Mohammad Banyan, Performance and fuel cell applications of reacted ball-milled MgH₂/5.3 wt% TiH₂ nanocomposite powders, RSC Adv., 2018, 8, 38175.

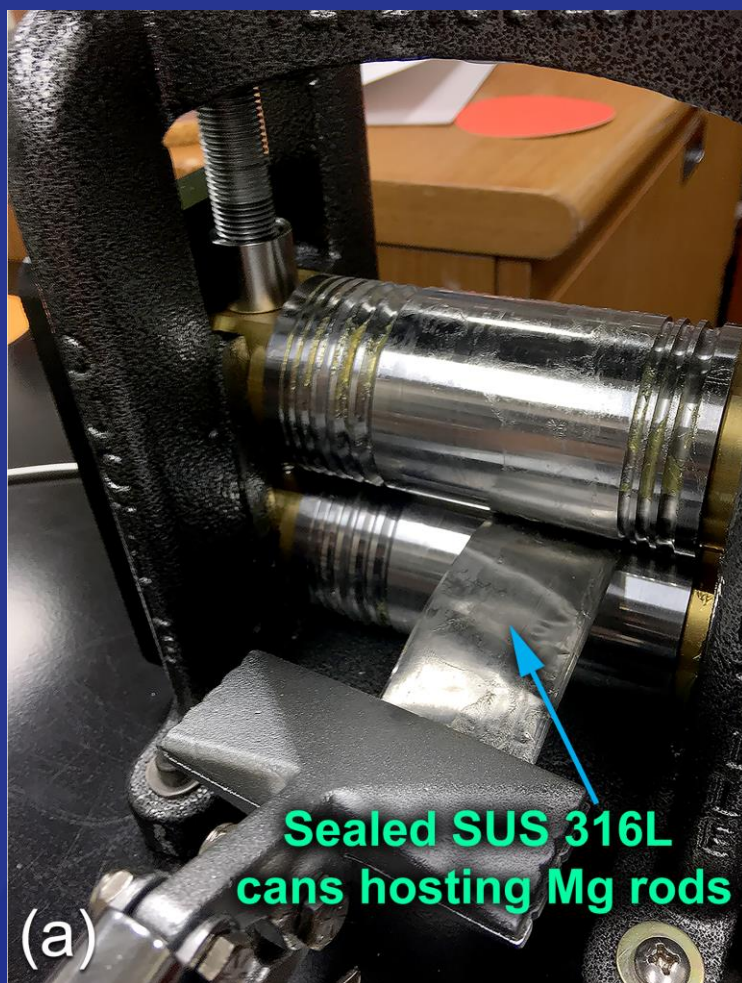


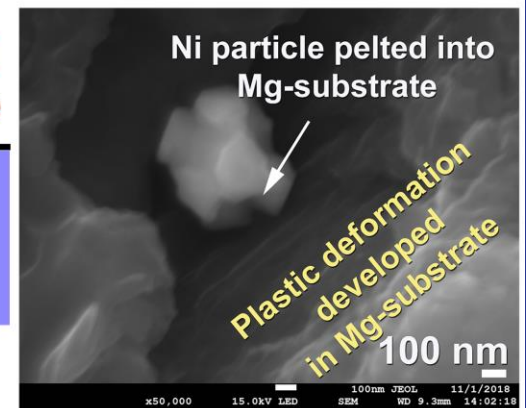
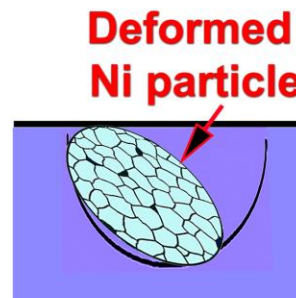
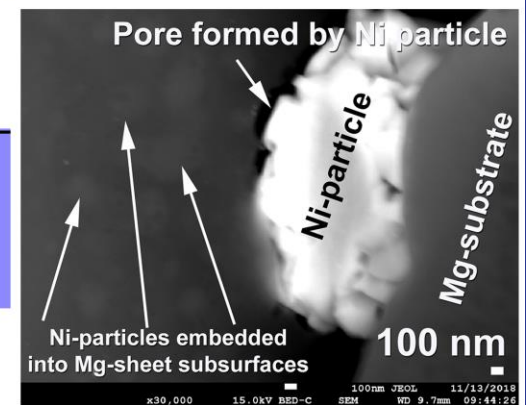
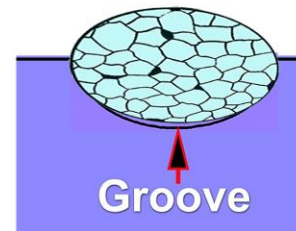
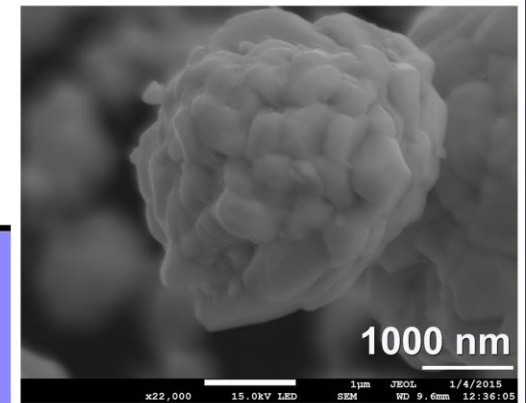
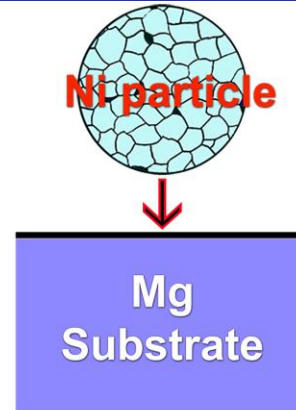
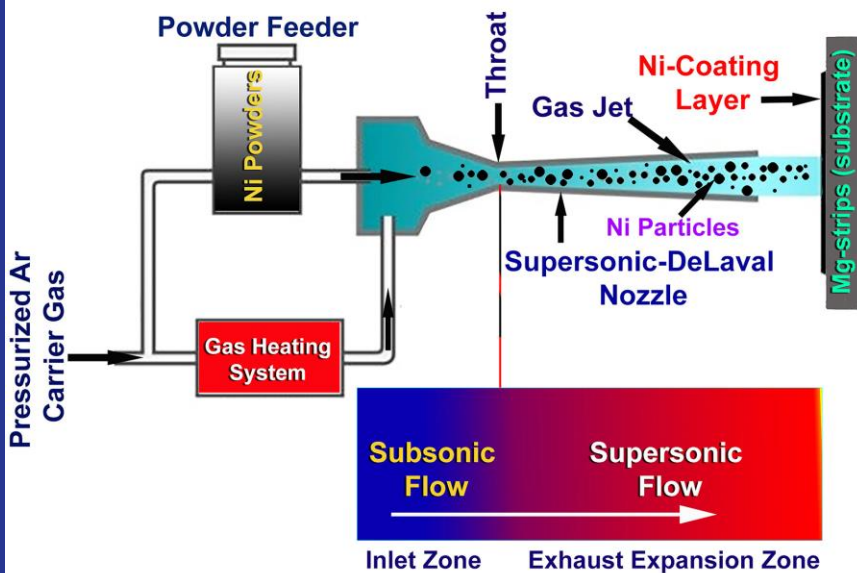
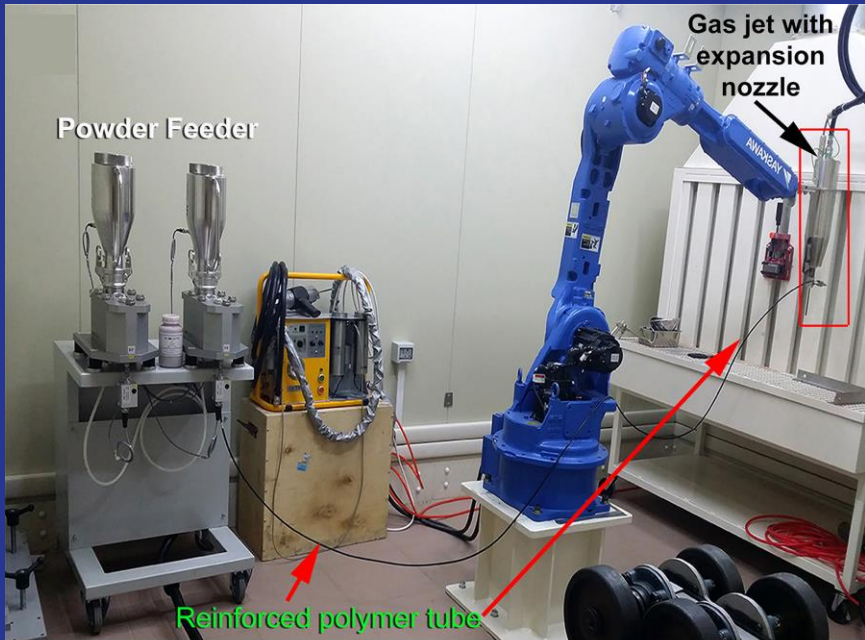
Metal/Metal Oxides Catalytic Agents

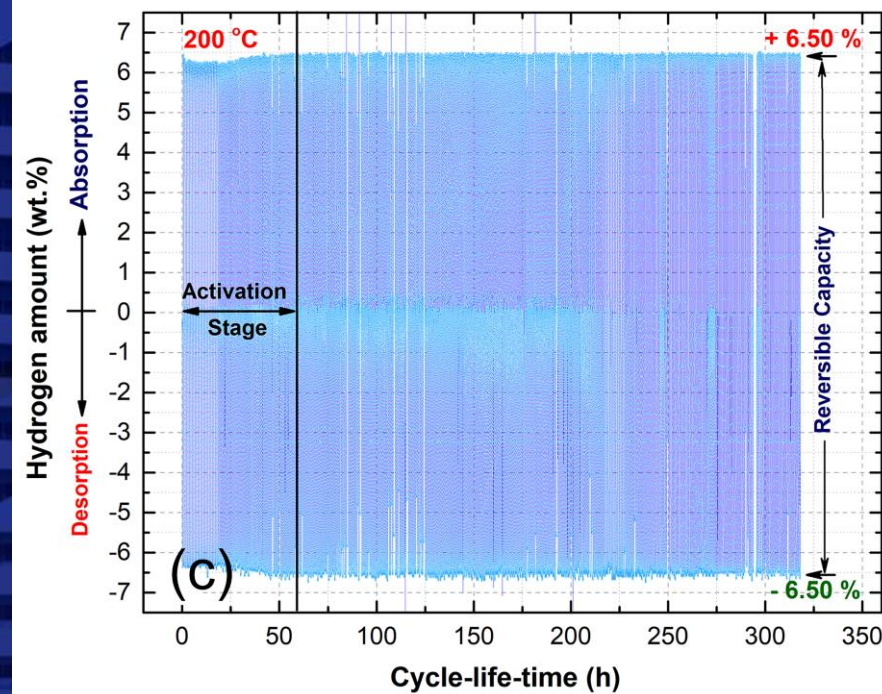
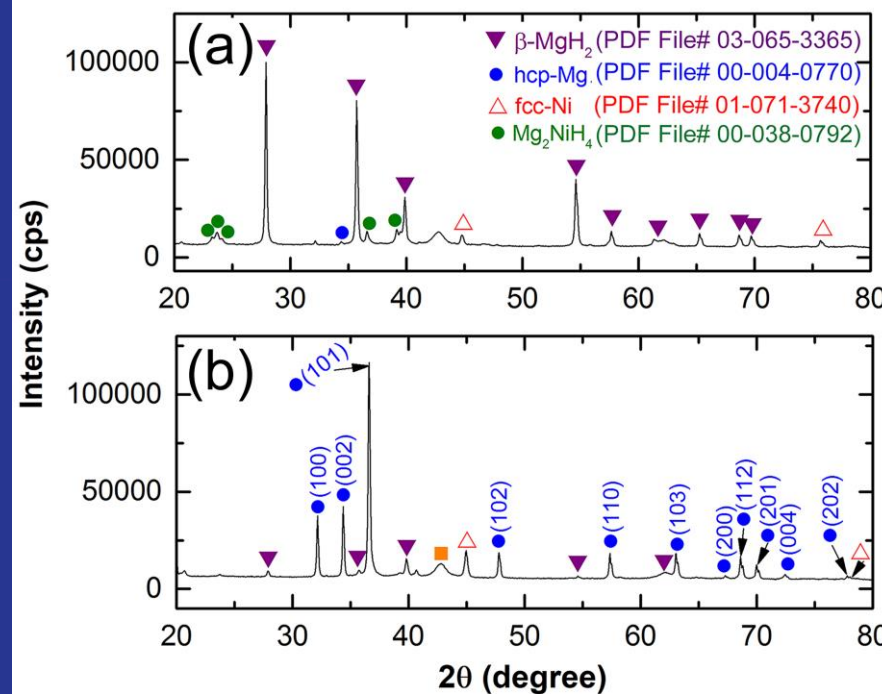
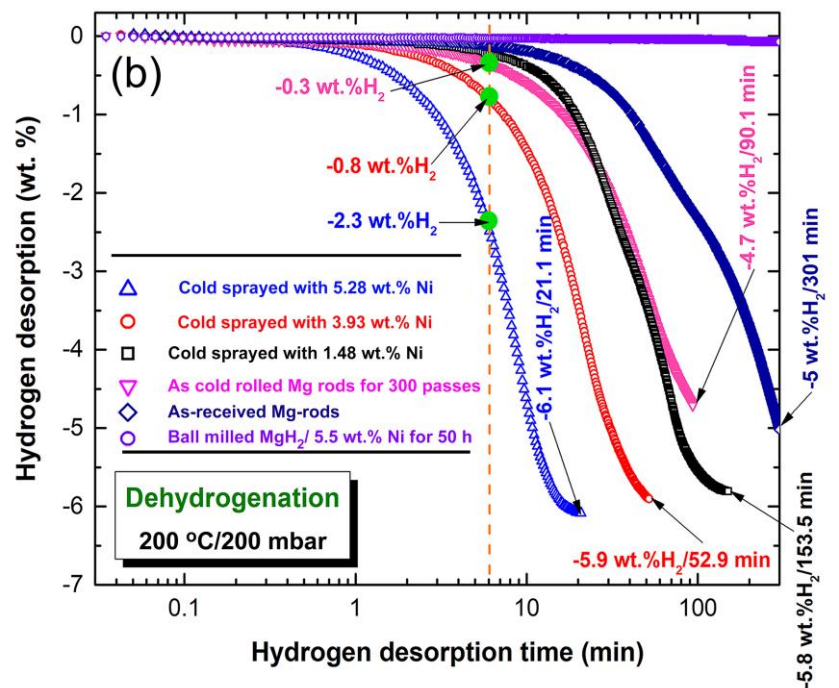
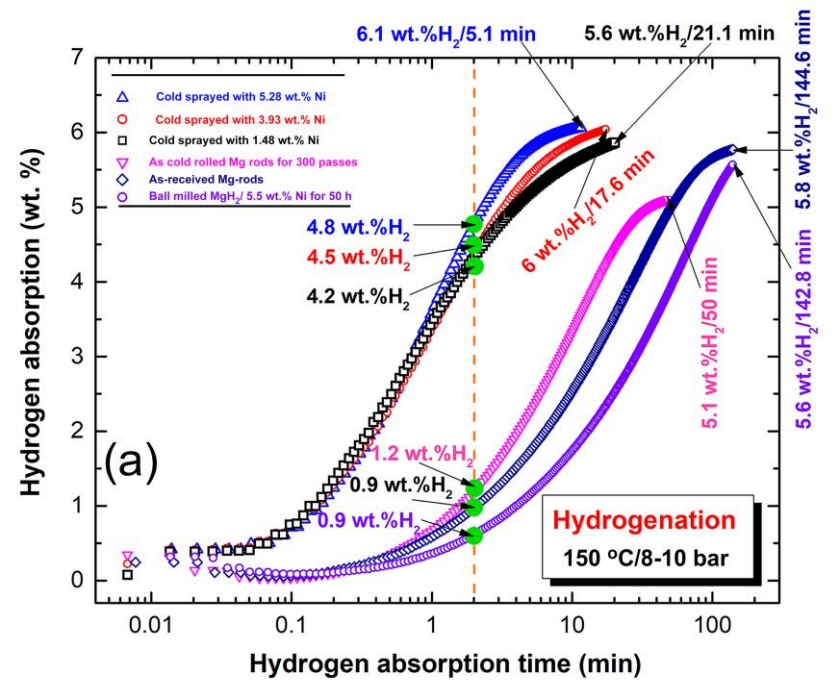




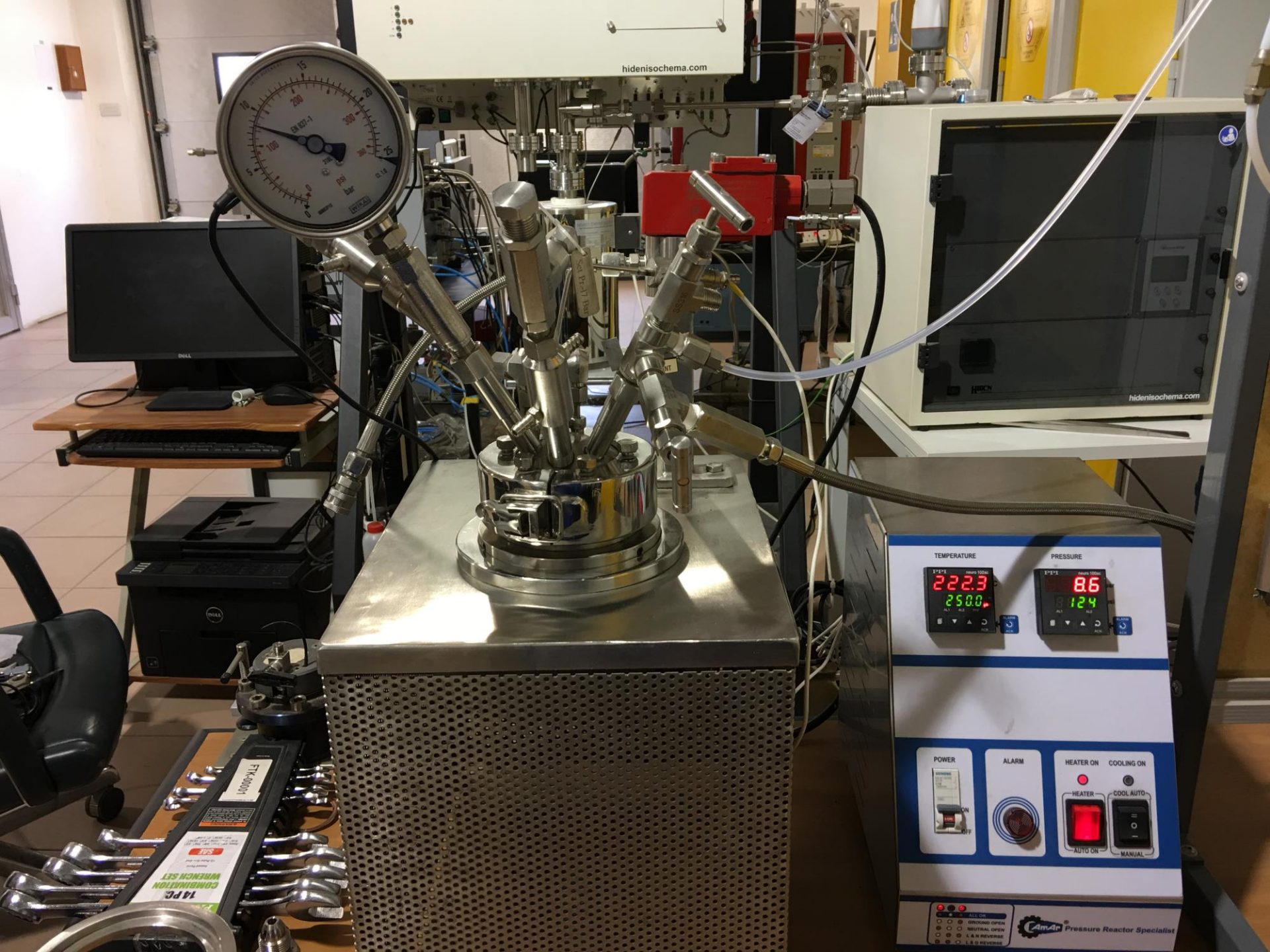
Catalyzation with Cold-Spray Approach







Application of MgH_2 -nanocomposites: Fuel Cells



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TEMPERATURE

TEMPERATURE
222.3
250.0

PRESSURE

PRESSURE
86
124

POWER

POWER
ON
OFF

ALARM

ALARM
ON
OFF

HEATER ON

HEATER ON
HEATER
COOL AUTO
AUTO ON
MANUAL

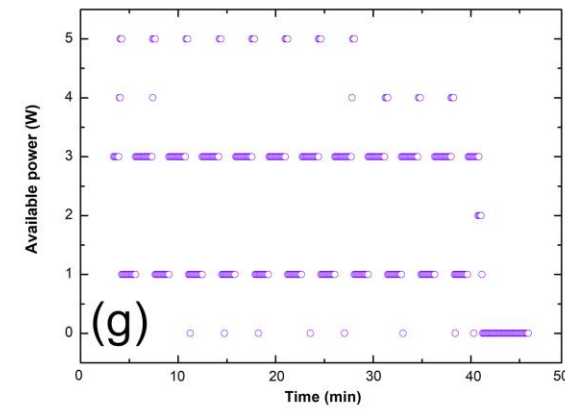
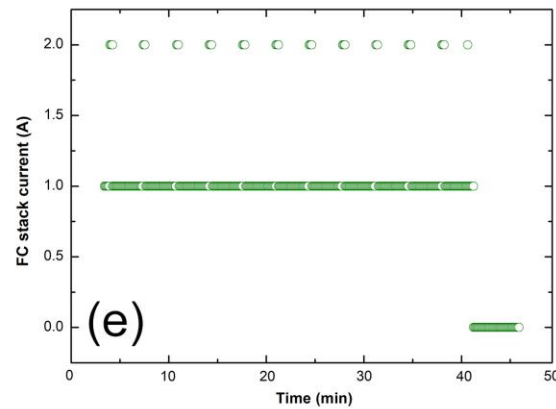
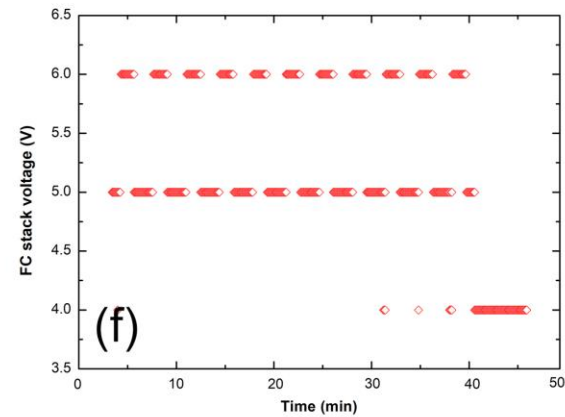
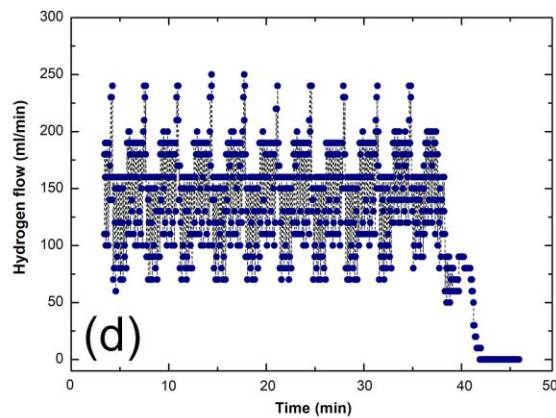
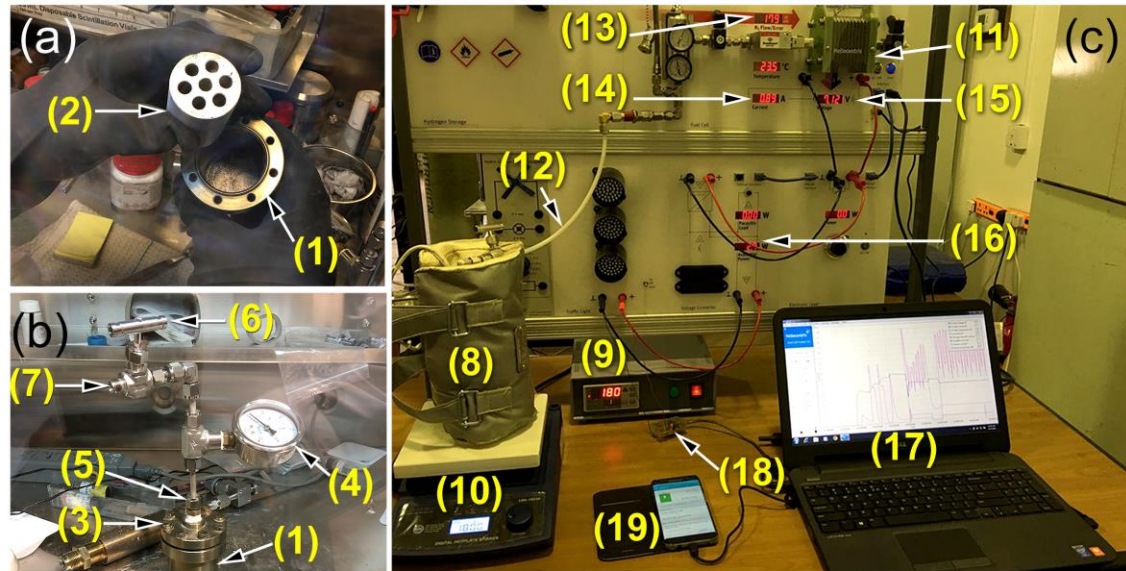
COOLING ON

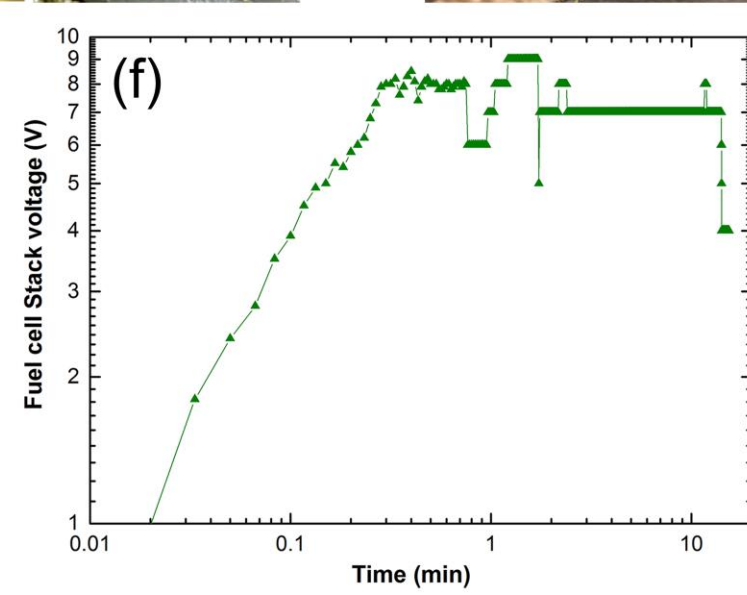
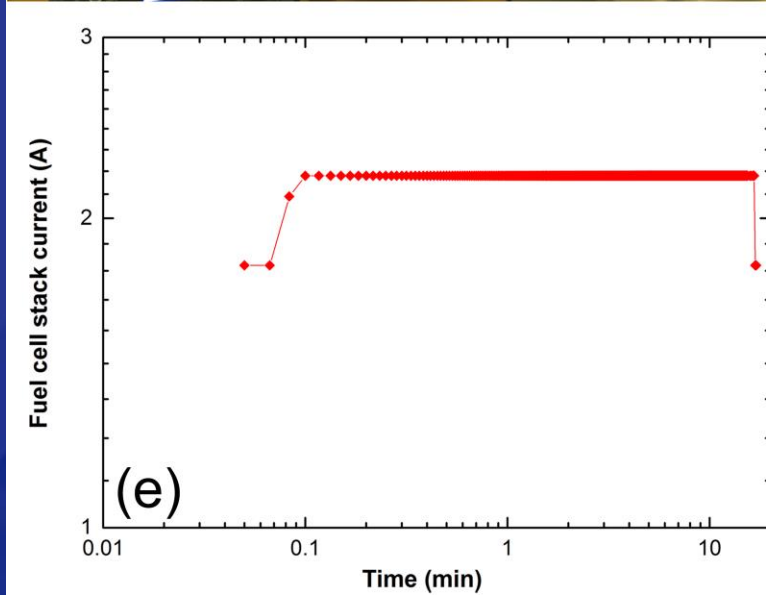
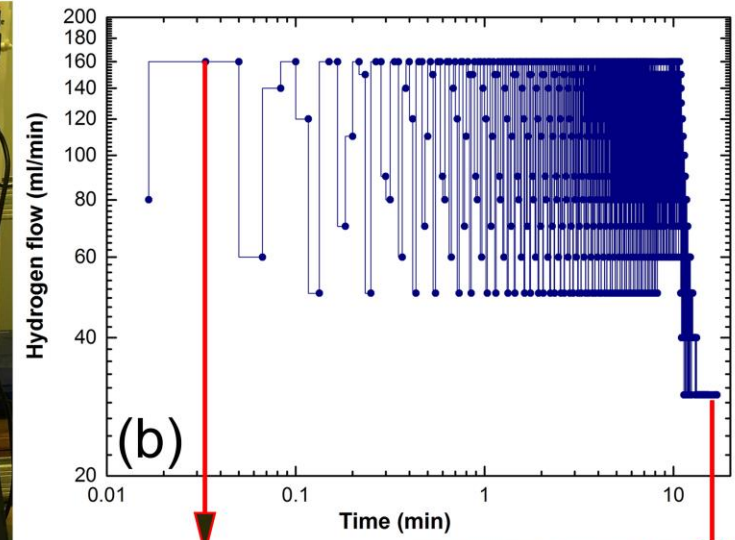
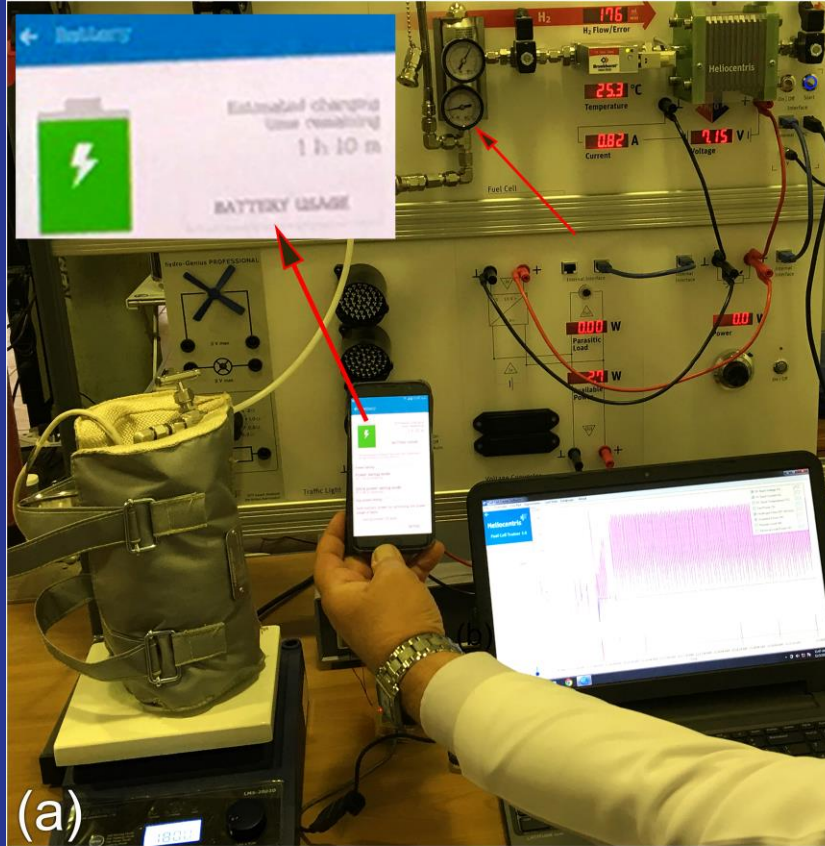
COOLING ON
COOL AUTO
AUTO ON
MANUAL

ALL ON
GROUND OPEN
NEUTRAL OPEN
L & N REVERSE
L & D REVERSE

AmAn Pressure Reactor Specialist

FTK4000
14 PC
CONDENSATION
W/REACTOR SET





(1) High pressure ball valve, (2) Hydrogen tank cap made of pure titanium metal with 8 hexagonal bolts (hexagonal head cap screws), (3) 8 cm high x 6.2 cm outer diameter x 5.4 cm inner diameter high-pressure hollow vessel made of pure titanium metal, (4) Outer SUS316 shield, (5) Inner heat shield made of alumina, (6) Copper heating elements, (7) Outer SUS316 tank filled with indium metal, (8) Outer transfer made of hollow-graphite wall bracket spacers with a diameter of 8.0 cm, an internal hollow circular cavity of 0.3 cm in diameter and a thickness of 1 cm, (9) Outer heat shield made of alumina, (10) Hydrogen tank outer bottom made of pure titanium metal, (11) A graphite crucible of 2.0 cm diameter and 1 cm high filled with pure indium metal mixed with 1 wt.% graphite powders, (12) Transfer made of solid graphite bracket-bottom spacer with a diameter of 5.3 cm and 0.3 cm thickness, (13) Outer heat shield made of alumina, (14) Pure graphite powders, (15) Transfer made of hollow-graphite wall bracket spacer with a diameter of 5.3 cm and 0.3 cm thickness, (16) Transfer made of Hollow graphite bracket spacers with a diameter of 5.4 cm, an internal hollow circular cavity of 0.3 cm in diameter and a thickness of 0.3 cm, (17) Nanocomposite $MgH_2/4$ wt.% $ZrNi_5/1$ wt.% Nb_2O_5 powders mixed with 1 wt.% of graphite powder, (18) Hollow-vertical graphite tube (7.4 cm length x 1 cm diameter), (19) Heat shield made of alumina, (20) A hexagonal head cap screw, (21) A high pressure gasket made of pure copper metal, (22) Hexagonal nut.

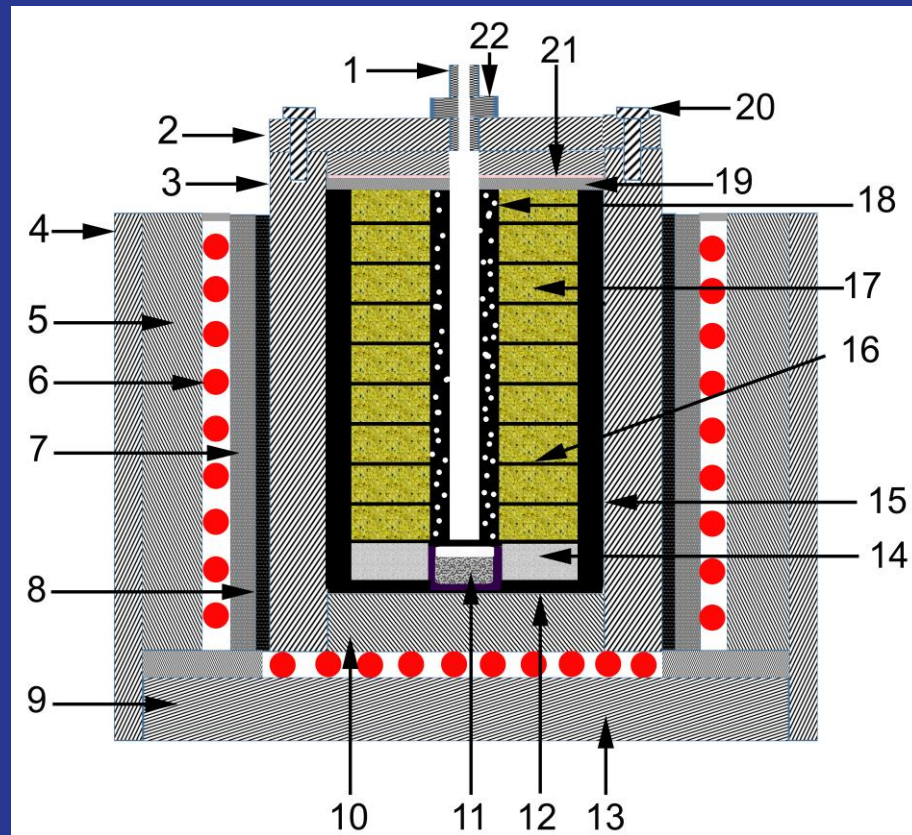


Figure Sketch drawing of the hydrogen storage tank invented in the present work.



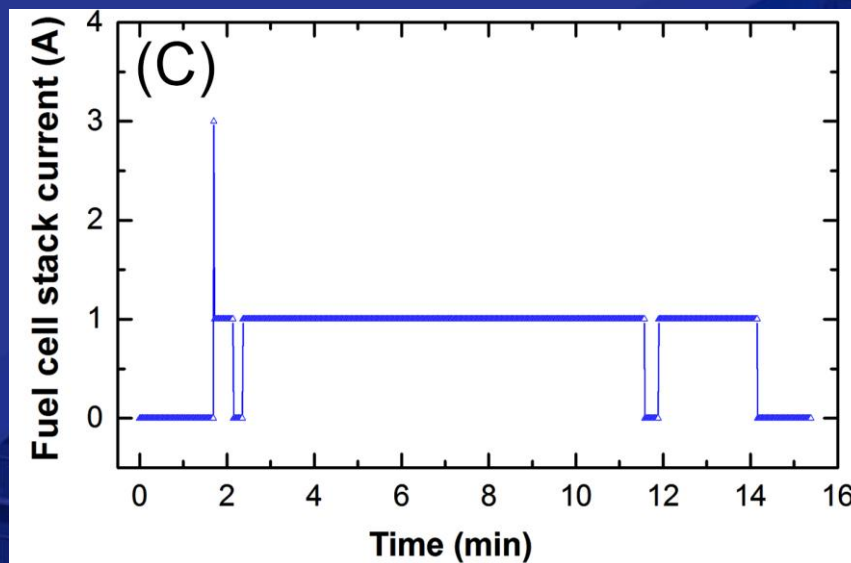
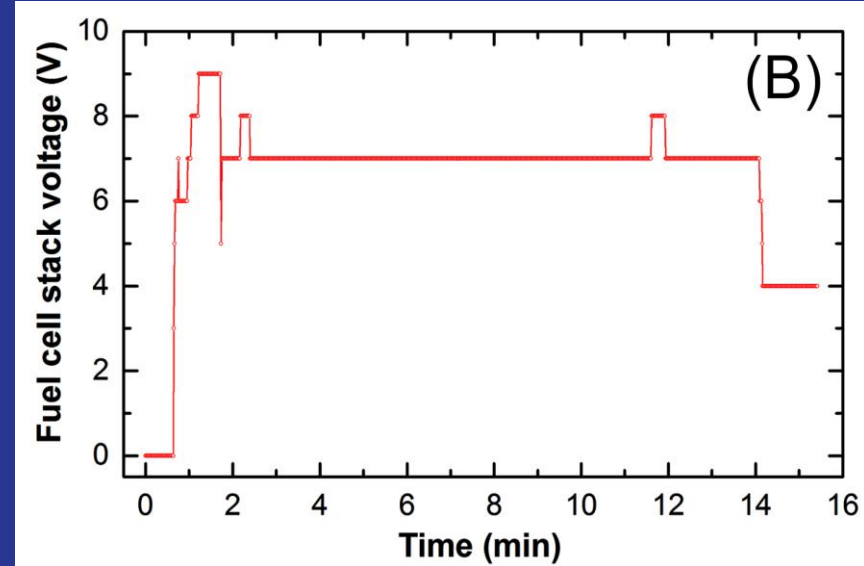
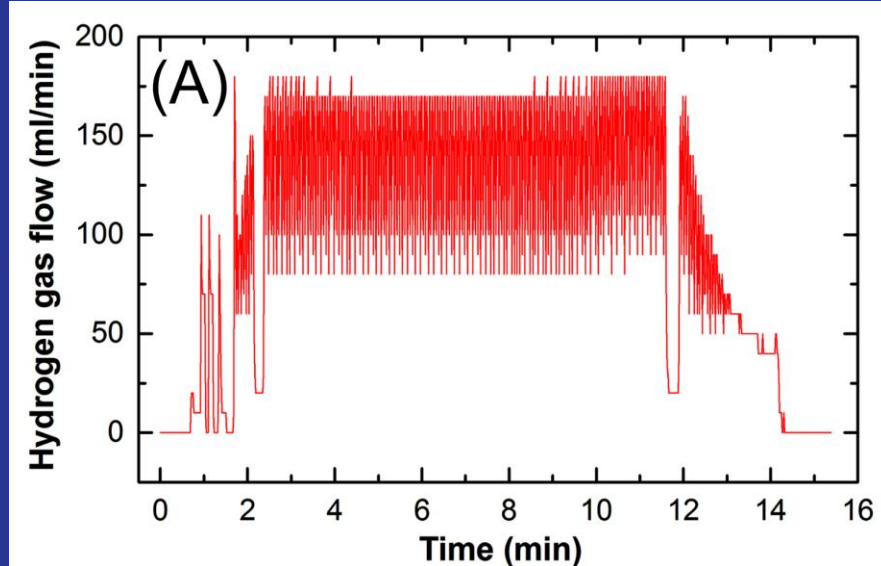
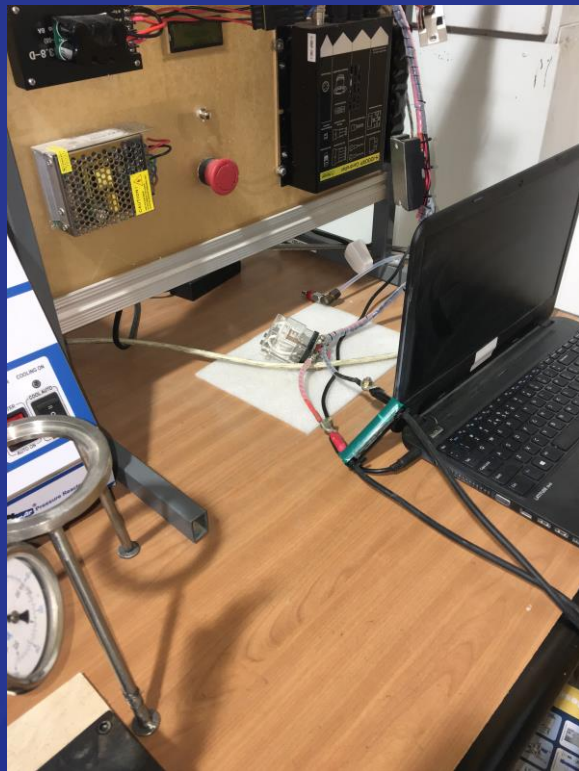
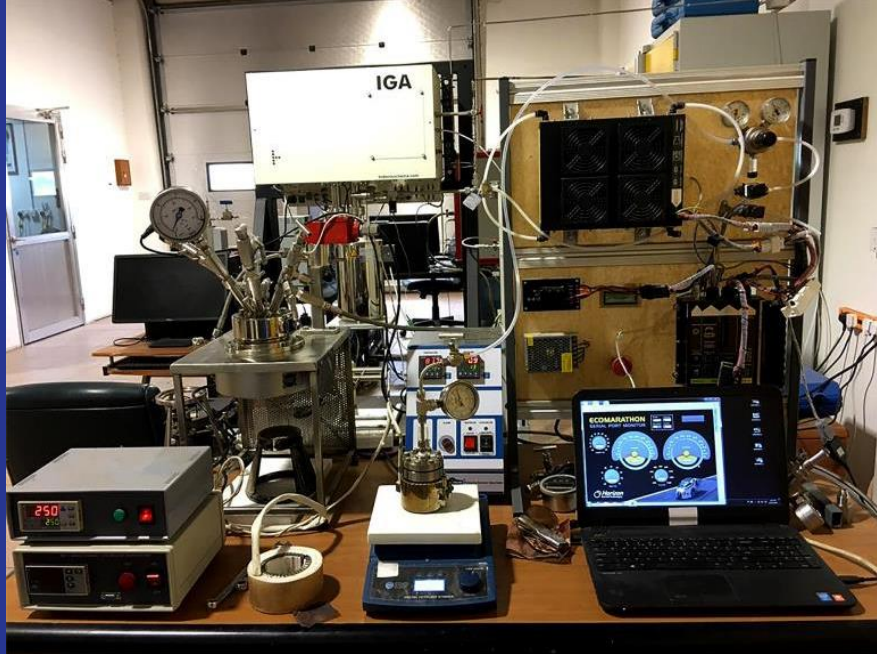
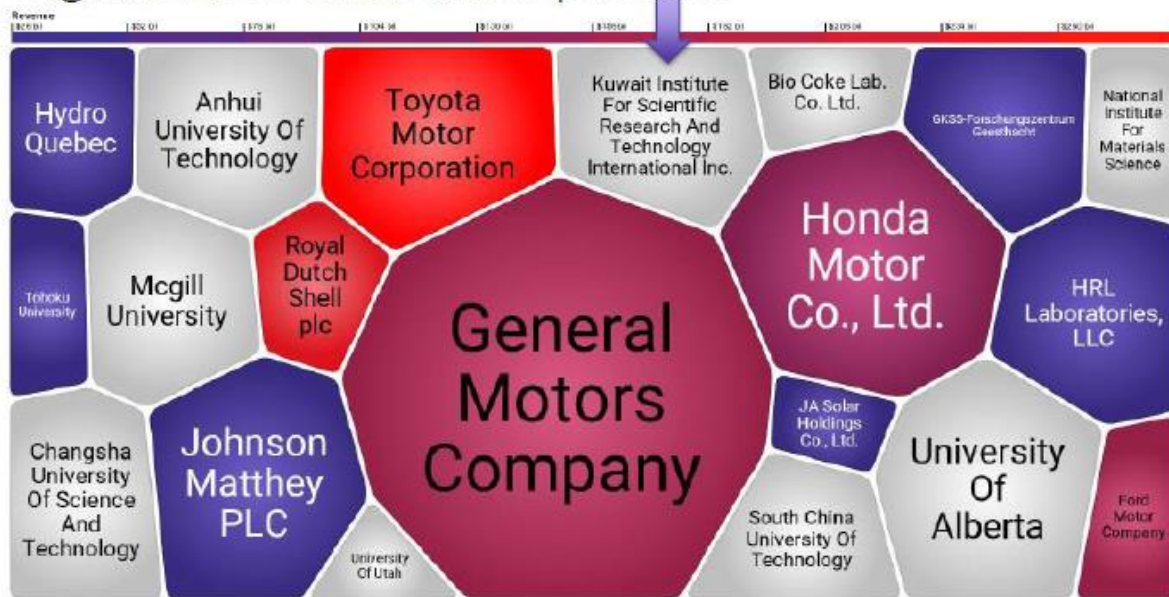


Figure Characterization of fuel cell system fed by hydrogen gas flow released from nanocomposite $\text{MgH}_2/(4\text{wt.}\% \text{ZrNi}_5 + 1\text{wt.}\% \text{Nb}_2\text{O}_5)$ powders. Correlation between the hydrogen gas flow, fuel cell stack voltage and stack current, and duration of time (16-min) for charging a cell phone device are shown in (A), (B) and (C), respectively.



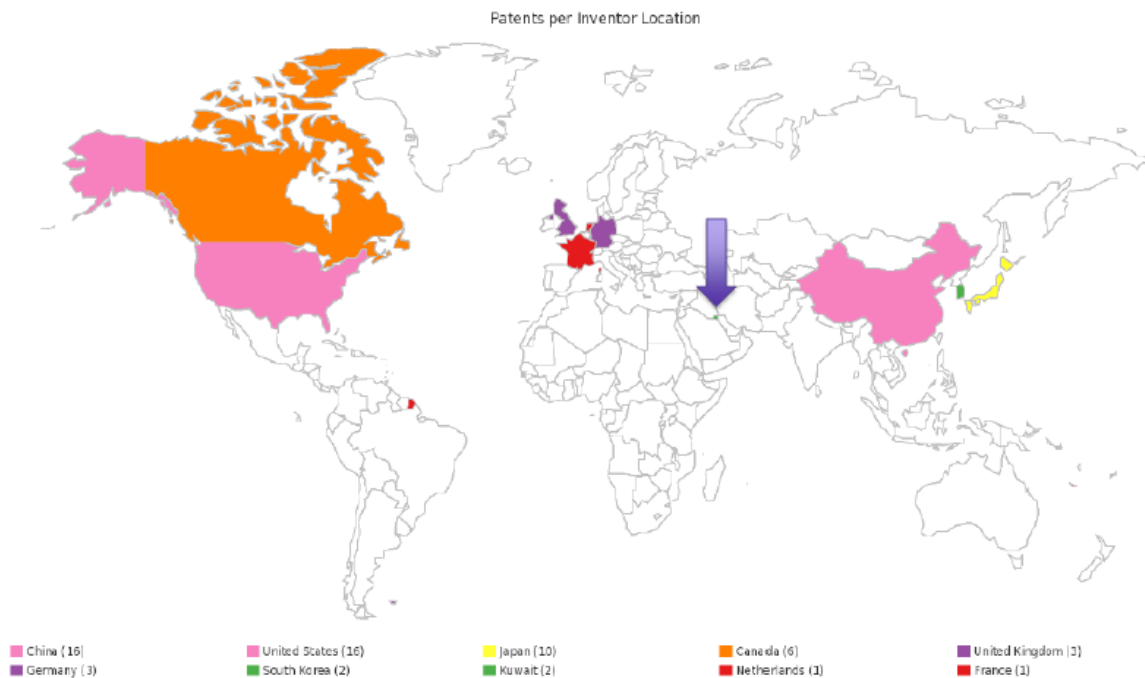


Organizations with similar patents:



- M. Sherif El-Eskandarany
Composition for Hydrogen Storage
US 9,533,884 B1, Jan. 3, 2017
- M. Sherif El-Eskandarany
Method for Synthesizing Nanodiamonds
US 9,540,245 B1, Jan. 10, 2017
- M. Sherif El-Eskandarany and Ahmed Al-Azmi
Metallic Glassy Alloy Powders for Antibacterial Coating
US 9,609,874 B1, April 4, 2017
- M. Sherif El-Eskandarany
Method for Synthesizing Nanodiamonds
WO 2017/151583 A1 September 8, 2017
- M. Sherif El-Eskandarany and Naser Ali et al.
Method of Synthesizing MgH₂/Ni Nanocomposites
US 9,828,245 B1 Nov. 28, 2017
- M. Sherif El-Eskandarany , Fahad Al-Ajmi, Mohammad Banyan
Nanocomposite system for solid hydrogen storage
US 10,364,148B1 July 30, 2019
- M. Sherif El-Eskandarany , Mohammad Banyan, Fahad Al-Ajmi
Method for Doping Magnesium with Nickel by Cold Spray Technique.
US 10,443,132 B1 Oct. 30, 2019

Active countries in the field:





الخاتمة

1. تُعد طاقة الهيدروجين هي الطاقة النظيفة الأنسب والأكثر أماناً ، التي من شأنها مساندة الطاقة المتولدة عن زيت النفط في ضمان استدامة الطاقة.
2. يمثل عنصر الماغنسيوم ذو الحبيبات النانوية الفلز الأمثل لتخزين الهيدروجين وتفريغه عند درجات حرارة وضغوط منخفضة القيمة.
3. يتم تحسين صفات شحن الهيدروجين وتفريغه خلال حبيبات الماغنسيوم النانوية عن طريق تحفيز العنصر بمحفزات فلزية رخيصة يمكن استخدامها مرات عديدة.
4. نموذج المركبة الكهربائية المقدم من معهد الكويت للأبحاث العلمية هو النموذج الوحيد على مستوى العالم والذي لا يتم فيه شحن بطاريات المركبة من خلال التيار الكهربائي المتردد المتولد عن حرق الوقود الأحفوري، بل يتم شحنها بواسطة خلايا الوقود الهيدروجينية.

1. يقترح أن تتفضل منظمة الأوابك الموقرة بالنظر في تبنى إنشاء مركزا بحثيا افتراضيا متخصصا في مجال إنتاج ، نقل ، تخزين الهيدروجين ، تطوير استخدامه في توليد الطاقة النظيفة المستخدمة في تطبيقات المركبات الخفيفة، الدراجات النارية، شحن وتشغيل الأجهزة الكهربائية المحمولة.
2. يقترح أن تتفضل المنظمة بالنظر في تعزيز ، ترسيخ ، والدعم المالى للمشاريع العلمية المشتركة بين الجامعات والمراكز البحثية بالدول الموقرة من أعضاء المنظمة ويتم تطويع كل الإمكانيات العلمية والمعملية المتاحة في تلك الدول ضمانا لنجاح المشاريع البحثية المشتركة.
3. يقترح أن تتفضل المنظمة بالنظر في تخصيص ميزانية محدودة تستخدم في توفير بعثات دراسية للخارج لشباب الباحثين من أبناء دول المنظمة وذلك لنيل درجات التخصص في الماجستير والدكتوراة بمجال الطاقة الهيدروجينية.
4. تتفضل المنظمة بتشكيل لجنة فنية/علمية متخصصة في هذا المجال لمتابعة وتنظيم المهام الخاصة بهذا



شكر مني بقلبي وتقدير
Thank You Very much

Sheif Albandarom