Thin Film Epitaxy: The Art of Laying Apples

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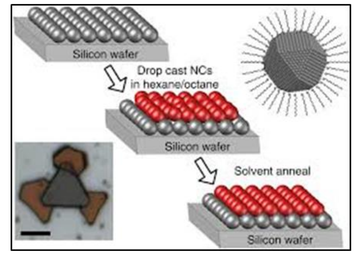
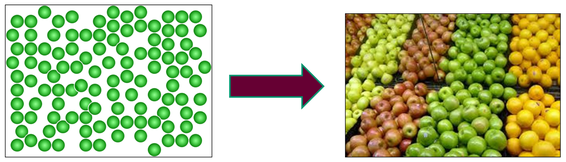
ABSTRACT:

Epitaxy simply refers to the process of depositing or growing crystal overlay on a substrate. Dr. Haiyan Wang's research group specializes on functional thin film materials. For example, coating high temperature superconductor material on a metal substrate. The resulting wafer is very flexible that can be used as cables for transmission lines or new generation motors. It can also be used to different electronic devices and other consumer product. Another area of their research revolves around thin film solid oxide fuel cells which are lighter but have a higher energy density capacity. Needless to say, this modern power supply is expected to last longer and charges at a shorter amount of time.



BACKGROUND



The "Art of Laying Apples" calls for epitaxy thin film growth. It includes homoepitaxy and heteroepitaxy which can also be divided to lattice matching epitaxy and domain matching epitaxy.

To grow high quality thin films:

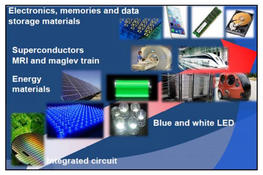
❖lay an ordered substrate with high quality crystal;

❖"apples" on the second layer and succeeding layers with similar size as the first layer;

❖"apples" on the second layer and succeeding layers have similar arrangement as the first layer;

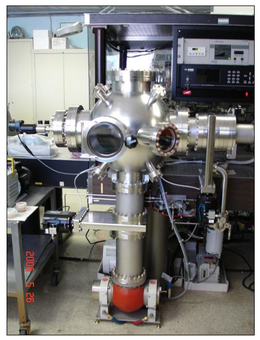
❖finally, right time and right condition

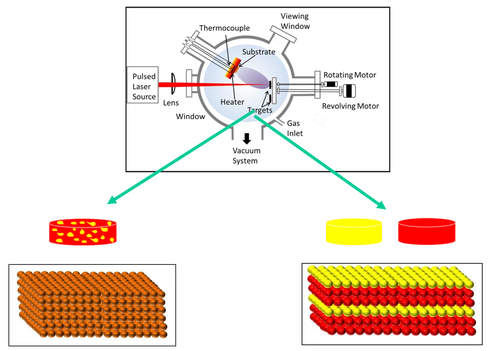
OBJECTIVE



This specific research aims to develop a lithium rich thin film cathode for a high energy density battery. In addition, it aims to produce a new generation power source that lasts longer and with shorter charging time. It targets various applications such as the automotive industry as well as portable consumer electronic products.

EXPERIMENTAL SETUP





Pulsed Laser Deposition

METHODOLOGY

❖**Chemical Deposition**
= a fluid precursor undergoes a chemical change at a solid surface, leaving a solid layer.

❖**Physical Deposition**
= uses mechanical, electrochemical or thermodynamic means to produce a thin film of solid.

➢Pulsed Laser Deposition
= pulses of focused laser light vaporize the surface of the target material and convert it to plasma where it reverts to an ionized gas then deposited on the substrate.

➢Direct Current Sputtering Deposition
= uses an electrical charge to ionize a noble gas in order to dislodge particles from the target then deposit it to the substrate.

RESULTS AND CONCLUSION

Through the "Functional Thin Film Research Group" of Dr. Haiyan Wang, a lesson module was developed which focuses on material science such as high energy density thin film lithium rich cathode. This material proved to be very promising in various consumer electronic products as well as the automotive industry.

An activity on this topic was also developed revolving around the basics of a typical electric circuit with emphasis on the design and construction of a simple wet cell. In addition, students correlate this with the practical applications and importance of this subject to their daily living.

REFERENCES

Jacob, Clement. "A New Approach to Investigate Li2MnO3 and LiO2 Mixed Phase Cathode Materials" *Journal of Material Science.* (2014), p. 2283.
Wang, Haiyan. The "Art of Laying Apples". Texas A&M University. Accessed July 1, 2015. http://www.ece.tamu.edu

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