**Journal Club Assignment #1**

**Titanium-Defected Undoped Anatase TiO2 with p-type Conductivity, Room-Temperature Ferromagnetism, and Remarkable Photocatalytic Performance**

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1. Define the following terms found in the abstract and/or introduction of this article. You may want to consult online sources or reference materials in the classroom.

* n-type semiconductor
* p-type semiconductor
* metal vacancies
* anatase TiO2
* Interstitials

2. From reading the introduction section, what is noteworthy about creating a material that contains metal vacancies as opposed to oxygen vacancies?

3. Consult Figure 3. Explain how portions (a-c) represent Ti-defected, O-interstitial, and normal structures of TiO2

4. Using Wikipedia research some basic information regarding positron annihilation spectroscopy. This is the type of experiment performed to analyze the types of metal vacancies. Briefly describe (in your own words) how this technique works.

5. Towards the end of section 3.2 positron annihilation is discussed and the results are summarized in Table 2. Why is the percentage I1 for τ1 of normal TiO2 so much smaller than that of defected TiO2?

6. Likewise, why is the percentage I2 for τ2 of normal TiO2 so much larger than that of defected TiO2?

7. If there are no VTi (titanium vacancies) in normal TiO2 why is there a τ1 lifetime at all for this compound?

8. Section 3.4 discusses the photocatalytic performance of the studied material. What reaction is being catalyzed? This reaction method has been studied very extensively since its discovery in 1972. Why is it so important?

9. When excited with UV light the material being studied forms electron-hole pairs. Do a little research regarding the formation of electron-hole pairs and draw a diagram depicting this process.

10. In this section it also mentions that a side reaction to this process is charge recombination. What is this and why is detrimental to H2 formation?