Student Document

Find the following article and its supplemental information from library resources:  Riha, S.C.; Parkinson, B.A.; Prieto, A.L. *J. Am. Chem. Soc.* **2011**, *133*, 15272-15275.

Answer the following discussion questions:

1.  What is the larger goal of the research project? What are the broader impacts of this work?

2.  What does the x in the empirical formula of Cu2ZnSn(S1-xSex)4 mean?

3.  Look up the structure of kesterite on Wikipedia. A. What is the composition of a single unit cell assuming that both the Zn and Fe sites are occupied by Zn? What is the empirical formula of the compound? B. How does this compare to the empirical formula of the compounds that were synthesized in this paper? C. How does it compare to the ratio of the reagents added?

4.  Why do the researchers use both HRTEM and PXRD to characterize the atomic structure of the nanoparticles? What complementary information is gained by using EDS? Why are multiple analytical techniques needed to characterize the materials in this paper?

5a.  Why does Se substitute for S in the solid solutions? How would this substitution change the structure of the materials? What would you expect to see in the PXRD data? What is the correlation between the change in the composition and the shifts in the PXRD peaks? How are your explanations consistent with the data observed in the paper?

5b.  How was the band gap determined experimentally measures (technique) and how is the data the data analyzed quantitatively? How does the increasing Se concentration affect the band gap?

6.  Explain Vegard’s law and how Vegard’s law holds true in this example. What evidence do the authors have to show that Vegard’s law is obeyed?

7.  What are some of the advantages and disadvantages of using the CZTS nanoparticles in solar cells?

8.  What was your favorite component of this activity and how did this help you to understand the article?

9.   What experiments would you propose to extend this work if you were the PI?