PUNE RESEARCH TIMES (ISSN 2456-0960)
AN INTERNATIONAL JOURNAL OF CONTEMPORARY STUDIES SPECIAL ISSUE FEB 2019

COMPARATIVE STUDY OF DIELECTRIC PROPERTIES OF CuO/ZnO NANOCOMPOSITE IN 1:1, 1:2 and 2:1 WEIGHT RATIO

[1]SAYYAD S. B., [2]G. G. PATIL, [3]KHIRADE P. W.

[1]Dept of Physics, Milliya Arts, Science & Management Science College, Beed, ***(MS) INDIA***
[2]Department of Electronic Science, K. T. H. M. College, Nashik, ***(MS) INDIA***
[3]Dept of Physics, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad, ***(MS) INDIA***

Abstract: *This article describes the dielectric properties of CuO/ZnO nanocmposite synthesized by mechanical milling method. The three samples are prepared in 1:1, 1:2 and 2:1 weight ratio of CuO and ZnO. The dielectric properties of three samples were investigated at 1MHz, 10MHz and 100MHz frequency in temperature range 0 to 100^0c. The broadband dielectric spectroscopy (BDS) is used for investigation of dielectric properties. The comparative study of three samples of CuO/ZnO nanocomposite was done and it was concluded that dielectric constant ε improves with increase in CuO weight percentage in sample. Also it rises with rise in temperature.*
Keywords*: Nanocomposite, dielectric constant, broadband dielectric spectroscopy.*

INTRODUCTION

The metal oxides nanocomposites are the most promising materials for electronic devices fabrications due to their surprisingly innovative properties as compared to their bulk material counterpart [1-5]. In this work we used CuO and ZnO as a basic metal oxide for synthesis of CuO/ZnO nanocomposite. The CuO is basically p-type semiconductor with narrow bandgap energy [6-9]. The ZnO is n-type semiconductor with wide bandgap energy [10, 11]. The CuO/ZnO nanocomposite were prepared by mechanical milling method. The CuO and ZnO research grade powder was used in the weight ratio 1:1, 1:2 and 2:1 weight ratio.

The formation of CuO/ZnO nanocomposite was confirmed using XRD. The synthesis part of this nanocomposite is published in our earlier paper [12]. The dielectric properties of three samples were investigated using the broadband dielectric spectroscopy (BDS). The variation of dielectric constant ε against temperature at 1MHz, 10MHz and 100MHz frequency respectively.

2. EXPERIMENTAL

2.1 Material

CuO and ZnO research grade powder was used to synthesize the samples.

2.2 Method

The mechanical milling method was used to prepare the CuO/ZnO nanocomposite sample in 1:1, 1:2 and 2:1 weight ratio.

3. RESULT AND DISCUSSION

3.1 Permittivity ε at 1MHz frequency

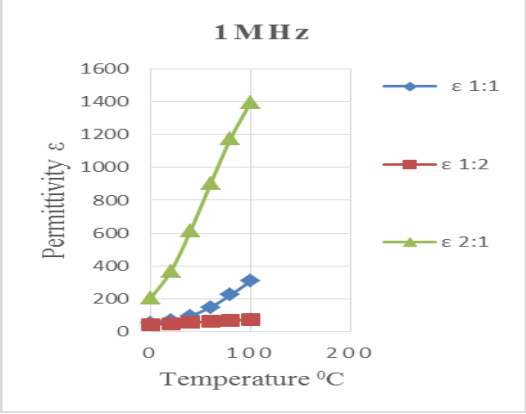

Fig.1 Permittivity ε as a function of temperature at 1MHz frequency

The graph of permittivity ε of CuO/ZnO nanocomposite sample in 1:1, 1:2 and 2:1 weight ratio against the temperature at 1MHz frequency is shown in figure1. From figure it is observed that permittivity ε of the sample is temperature dependent. Also the value of permittivity ε increases drastically with increase in weight percentage of CuO in the sample. While with increase in weight ratio of ZnO in sample, the permittivity ε decreases, while it is moderate for equal weight ratio 1:1.

3.2 Permittivity ε at 10 MHz frequency

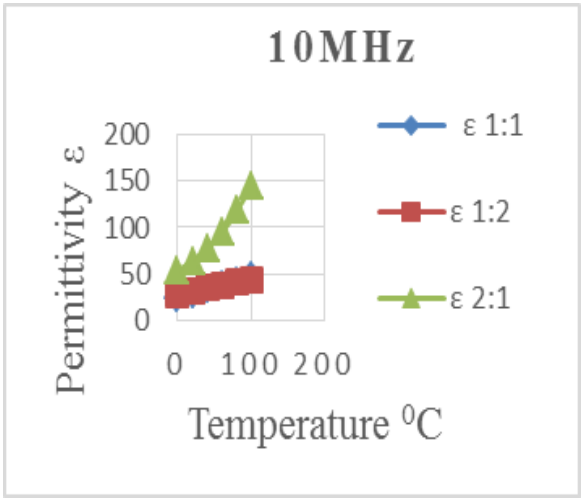

Fig.2 Permittivity ε as a function of temperature at 10MHz frequency

The graph of permittivity ε against temperature at 10MHz frequency is shown in figure 2. Here we can observe that the response of the three samples are almost identical to earlier but there is reduction in value of permittivity ε is observed. The highest value of permittivity is for CuO/ZnO in 2:1 weight ratio and it is 145, which is quite low than previous 1395.

3.3 Permittivity ε at 100 MHz frequency

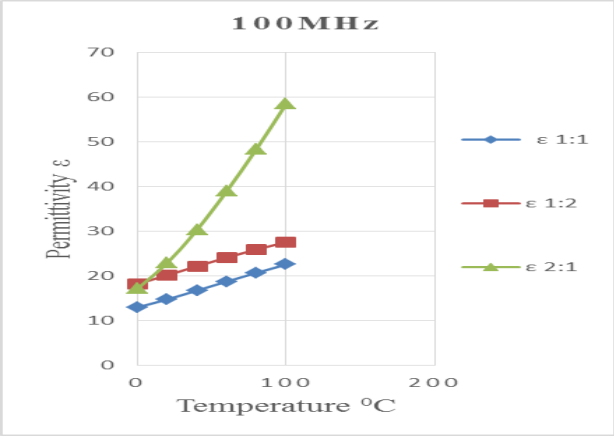

Fig.3 Permittivity ε as a function of temperature at 100MHz frequency

The graph of permittivity ε against temperature at 100MHz frequency for CuO/ZnO nanocomposite is shown in figure 3. Again the same response is observed. The value of permittivity ε found to be reduced with increase in frequency. The highest value of permittivity is 58 for CuO/ZnO in 2:1 weight ratio.

4. CONCLUSION

From the above results of figure1, 2 and 3, we can conclude that there is significant impact of weight percentage CuOand ZnO on the value of permittivity ε. The permittivity value found to be increased with in in CuO weight percentage (2:1) while it decreased with increase in weight percentage of ZnO (1:2). The permittivity value is moderate for equal weight percentage 1:1. Also the permittivity is found to be decreased with increase in the frequency from 1MHz to 100MHz. It is due to the polarization of CuO/ZnO nanocomposite particles at the higher frequency.

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