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Structural and Optical Characterization of Bis-(4-Hydroxy-1-Naphthyl) Phenylmethanol-Doped Polyvinyl Alcohol Films

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***Abstract*- Consistent Bis-(4-Hydroxy-1-Naphthyl) phenylmethanol (BHP)-doped PVA film was effectively deposited by applying the casting process to prepare several samples with varying concentrations. The BHP: PVA film was analyzed using atomic force microscopy (AFM), which created histograms, distributed intensity assessments, and microscopic surface scanning. The complex aromatic structure of BHP is expected to enhance light absorption and improve electrical conductivity in the PVA matrix. The optical properties were investigated, including absorbance spectrum, optical bandgap, Urbach energy, extinction coefficient, and dielectric function. Doping PVA with BHP reduced the energy gap and increased the Urbach tail as the dye concentration increased, with a reversal of this behavior observed at a 100% BHP concentration ratio. The irregular behavior observed in this study suggests that molecular aggregation becomes effective at high doping degrees, which opens a new way to modify the optical properties of polymer-based films.**

***Index Terms*- Spectroscopy, Optical properties, BHP compound, PVA.**

I. INTRODUCTION

The growing demand for efficient and adaptable optoelectronic devices has sparked advancements in materials research. Synthetic organic dyes have emerged as viable possibilities among these materials due to their remarkable capacity to absorb and emit light, together with their chemical diversity. The properties of synthetic dyes enable use in several applications, including pH indicators, dye-sensitized solar cells, and—most significantly for our focus—optoelectronic devices [1-6]. Recent research has emphasized the exceptional non-linear optical (NLO) features of synthetic dyes, essential for applications in optical switching, light modulation, and signal processing [7-11]. Synthetic compounds, in contrast to conventional inorganic materials, have exceptional plasticity and tunability, facilitating the creation of customized solutions adapted to specific requirements in applications [12-15].

The chemical compound bis-(4-hydroxy-1-naphthyl) phenyl-methanol, an organic compound known as phenolphthalein, has garnered significant interest due to its unique molecular structure and optical properties. Phenolphthalein, commonly utilized as a pH indicator in analytical chemistry, possesses notable absorption and emission properties that make it suitable for many optoelectronic applications. The conjugated structure of phenolic hydroxyl groups could be useful for optical sensors or fluorescent probes because they can act as auxochromes that improve color characteristics, fluorescent probes [16-18], development of new lasers [19, 20],