Environmentally Friendly Oxidation of Primary Amines Inspired by the Traffic Light Reaction

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The traffic light reaction is a visual chemistry magic experiment that allows the observation of redox reactions. This reaction involves the blue dye indigo carmine (IC) being reduced by glucose under basic conditions, forming a yellow reduced form via an intermediate red stage, and then reverting back to the original IC upon oxidation by air. Overall, the reaction can be viewed as the air oxidation of glucose catalyzed by IC. Last year, it was discovered that the traffic light reaction also occurs when primary amines are used instead of glucose, but the structure of the product remained unknown. Therefore, I conducted research using benzylamine to investigate this reaction in detail, aiming to elucidate the product's structure and establish this reaction as a new oxidation reaction for primary amines. I stirred an aqueous solution of benzylamine containing 1 mol % IC under air at 25°C and determined the product structure by comparing the products obtained from the reaction with authentic samples of possible products using ^{1}H-NMR spectra and thin-layer chromatography. The results revealed that benzaldehyde and N-benzylidene benzylamine were obtained in relatively good yields as oxidation products of benzylamine. Furthermore, the reaction was examined by varying reaction time and temperature to explore conditions for obtaining oxidation products in good yields. It was also confirmed that similar reactions proceed for other primary amines. Thus, based on the traffic light reaction, I successfully developed a new reaction for oxidizing primary amines with low environmental impact, simple operation, and low cost.

Awards Won: