Breast cancer is the most common type of cancer among women in the western world. While mammography is regarded as the most effective tool for the detection and diagnosis of breast cancer, the interpretation of mammograms is a difficult and error-prone task. Hence, computer aids have been developed that assist the radiologist in the interpretation of mammograms. Computer-aided detection (CADe) systems address the problem that radiologists often miss signs of cancers that are retrospectively visible in mammograms. Furthermore, computer-aided diagnosis (CADx) systems have been proposed that assist the radiologist in the classification of mammographic lesions as benign or malignant. While a broad variety of approaches to both CADe and CADx systems have been published in the past two decades, an extensive survey of the state of the art is only available for CADe approaches. Therefore, a comprehensive review of the state of the art of CADx approaches is presented in this work. Besides providing a summary, the goals for this article are to identify relations, contradictions, and gaps in literature, and to suggest directions for future research. Because of the vast amount of publications on the topic, this survey is restricted to the two most important types of mammographic lesions: masses and clustered microcalcifications. Furthermore, it focuses on articles published in international journals.