On the free boundary in heterogeneous problems of obstacle-type with two phases

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We consider some properties of the solutions of free boundary problems of obstacle-type with two phases for a class of heterogeneous quasilinear elliptic operators, including the p-Laplacian operator with $1 < p < \infty$. Under a natural non-degeneracy assumption on the interface, when the level set of the change of phase has null Lebesgue measure, we prove a continuous dependence result for the characteristic functions of each phase and we establish sharp estimates on the variation of its Lebesgue measure with respect to the L^1-variation of the data, in a rather general framework. For elliptic quasilinear equations which heterogeneities have appropriate integrable derivatives, we show that the characteristic functions of both phases are of bounded variation for general data with bounded variation. This extends recent results for the obstacle problem and is a first result on the regularity of the free boundary of the heterogeneous two phases problem, which is therefore an interface locally of class C^1 up to a possible singular set of null perimeter.