Durable Retroreflective Elements with an Ionic Copolymer Core

Technical Field

The present disclosure relates to retroreflective elements with an ionic copolymer core.

Background

Pavement or road markings (*e.g.*, paints, tapes, and individually mounted articles) guide and direct motorists and pedestrians traveling along roadways and paths. Pavement or road markings can be used on, for example, roads, highways, parking lots, and recreational trails. Typically, pavement markings form stripes, bars, and markings for the delineation of lanes, crosswalks, parking spaces, symbols, legends, and the like. Paint was a preferred pavement marking for many years. Retroreflective liquid pavement markings typically include retroreflective elements. Retroreflective liquid pavement marking offer significant advantages over paint, such as increased visibility, retroreflectance, improved durability, and temporary and/or removable marking options. Such retroreflective elements are described in, for example, U.S. Patent Nos. 5,750,191; 5,774,265; 5,942,280; 7,513,941; 8,591,044; 8,591,045; and U.S. Patent Publication Nos. 2005/0100709 and 2005/0158461, all of which are incorporated herein in their entirety. Commercially available retroreflective elements include, for example, All Weather Elements made by 3M Company of St. Paul, MN. Typically, a retroreflective element includes a core adjacent to numerous glass or glass ceramic beads that are adhered to the outermost surface of the core by a binder.

As is described in, for example, U.S. Patent Publication No. 2005/0100709, the retroreflective elements are applied onto or into liquid roadway or pavement markings or compositions such that at least a portion of most of the retroreflective elements extends above or out of the roadway or pavement marking. Light that is transmitted by a light source (*e.g.*, a streetlight or a car's headlights) is incident on the retroreflective liquid pavement marking (and the retroreflective elements therein) is retroreflected by the retroreflective elements in the roadway marking. Specifically, the glass or glass ceramic beads transmit incident light back toward the incoming light source.

Pavement or road markings are subject to continuous wear and exposure to the elements as well as road chemicals. Consequently, there is a need for the materials used in pavement or road marking compositions that provide durability and retained reflectivity once applied to a surface.

Summary

In one aspect, there is provided a reflective element comprising: a substantially spherical core comprising an ionic copolymer; a plurality of beads in contact with the core on at least a portion of the perimeter of the core.

The disclosed retroreflective element includes a highly durable core with an ionic copolymer. These disclosed retroreflective properties remain intact even after continued application of external forces and stresses. Further, the ionic copolymer allows for bead to be loaded into the ionic copolymer of the core, securely disposed around the perimeter of the core, or both.

In one embodiment, the reflective element comprises a core comprising an ionic copolymer and a plurality of beads. In one embodiment, the core uniformly comprises an ionic copolymer. In one

What is claimed is:

1. A reflective element comprising:

a substantially spherical core comprising a ionic copolymer;

a plurality of beads in contact with the core on at least a portion of the perimeter of the core.

2. The reflective element of claim 1, wherein the core uniformly comprises an ionic copolymer.

3. The reflective element of any one of the preceding claims, wherein the core is a composite core.

4. The reflective element of any one of the preceding claims, wherein the plurality of beads are dispersed throughout the composite core.

5. The reflective element of any one of the preceding claims, wherein the plurality of beads are disposed at a portion of the perimeter of the core.

6. The reflective element of any one of the preceding claims, wherein the plurality of beads are disposed at the entire perimeter of the core.

7. The reflective element of any of the preceding claims, wherein the ionic copolymer includes no more than 15 mole percent of ionized units covalently bonded to a polymer backbone as pendant group moieties.

8. The reflective element of any of the preceding claims, wherein the ionic copolymer is an ionically cross-linked ethylene methacrylic acid copolymer.

9. The reflective element of any of the preceding claims, wherein the core further comprises one or more pigments.

10. The reflective element of any one of the preceding claims, wherein the beads are a glass or glass ceramic beads.

11. The reflective element of any one of the preceding claims, wherein the beads have a mean refractive index ranging from 1.5 to 2.6.

12. The reflective element of any one of the preceding claims, wherein the bead have an average diameter ranging from 30 to 200 microns.

13. The reflective element of any of the preceding claims, further comprising a plurality of second beads.

14. The reflective element of any of the preceding claims, wherein the second beads are disposed along a portion of the perimeter.

15. The reflective element of any one of the preceding claims, further comprising a plurality of second beads disposed at the entire perimeter of the core.

16. The reflective element of any of the preceding claims, wherein the second beads are dispersed throughout the ionic copolymer of the core.

17. The reflective element of any one of the preceding claims, wherein the second beads are a glass or glass ceramic bead.

18. The reflective element of any one of the preceding claims, wherein the second bead have a second refractive index ranging from 1.5 to 2.6.

19. The reflective element of any one of the preceding claims, wherein the second beads have an average diameter ranging from 30 to 200 microns.

20. The reflective element of any of the preceding claims, wherein the bead has a first refractive index, and the second bead has a second refractive index that is different that the first refractive index.

21. The reflective element of any one of the preceding claims, wherein the beads are fixed to the perimeter of the core by one of the ionic copolymer, a softening material, or an adhesive.

22. The reflective element of any one of the preceding claims, wherein the reflective elements are secured to a substrate by an adhesive, paint, resin.