FILM BULK ACOUSTIC RESONATOR INCLUDING RECESSED FRAME WITH SCATTERING SIDES

BACKGROUND

Technical Field

Embodiments of this disclosure relate to acoustic wave devices and structures and methods of mitigating spurious signals in same.

Description of Related Technology

Acoustic wave devices, for example, bulk acoustic wave (BAW) devices may be utilized as components of filters in radio frequency electronic systems. For instance, filters in a radio frequency front end of a mobile phone can include acoustic wave filters. Two acoustic wave filters can be arranged as a duplexer.

SUMMARY

In an aspect, the present disclosure refers to a film bulk acoustic wave resonator (FBAR) comprising a recessed frame region including an undulating perimeter, and a raised frame region including an undulating perimeter.

In an aspect, the present disclosure refers to a radio frequency filter comprising a film bulk acoustic wave resonator (FBAR) having a recessed frame region including an undulating perimeter, and a raised frame region including an undulating perimeter.

In an aspect, the present disclosure refers to an electronics module comprising a radio frequency filter including a film bulk acoustic wave resonator (FBAR) having a recessed frame region including an undulating perimeter, and a raised frame region including an undulating perimeter.

In an aspect, the present disclosure refers to an electronic device comprising an electronics module including a radio frequency filter having a film bulk acoustic wave resonator (FBAR) with a recessed frame region including an undulating perimeter, and a raised frame region including an undulating perimeter.

In accordance with one ~~aspect~~example, there is provided a film bulk acoustic wave resonator (FBAR) comprising a recessed frame region including an undulating perimeter.

In some examples~~embodiments~~, the undulating perimeter is an internal perimeter of the recessed frame region.

In some examples~~embodiments~~, an outer perimeter of the recessed frame region is non-undulating.

In some examples~~embodiments~~, the undulating perimeter is an outer perimeter of the recessed frame region.

In some examples~~embodiments~~, an inner perimeter of the recessed frame region is non-undulating.

In some examples~~embodiments~~, the recessed frame region includes both an undulating inner perimeter and an undulating outer perimeter.

In some examples~~embodiments~~, undulation of the inner perimeter is in phase with undulation of the outer perimeter.

In some examples~~embodiments~~, undulation of the inner perimeter is out of phase with undulation of the outer perimeter.

In some examples~~embodiments~~, The FBAR further comprises a raised frame region including an undulating perimeter.

In some examples~~embodiments~~, the raised frame region includes an undulating inner perimeter.

In some examples~~embodiments~~, undulation of the perimeter is periodic.

In some examples~~embodiments~~, undulation of the perimeter is non-periodic.

In some examples~~embodiments~~, the recessed frame region is apodized.

In some examples~~embodiments~~, the recessed frame region is non-apodized.

In accordance with another examples~~aspect~~, there is provided a radio frequency filter comprising a film bulk acoustic wave resonator (FBAR) having a recessed frame region including an undulating perimeter.

In accordance with another example~~aspect~~, there is provided an electronics module comprising a radio frequency filter including a film bulk acoustic wave resonator (FBAR) having a recessed frame region including an undulating perimeter.

In accordance with another example~~aspect~~, there is provided an electronic device comprising an electronics module including a radio frequency filter having a film bulk acoustic wave resonator (FBAR) with a recessed frame region including an undulating perimeter.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of this disclosure will now be described, by way of non-limiting example, with reference to the accompanying drawings.

FIG. 1 is a cross-sectional view of an example of film bulk acoustic wave resonator;

FIG. 2 is a plan view of an example of a film bulk acoustic wave resonator;

FIG. 3 is a plan view of another example of a film bulk acoustic wave resonator;

FIG. 4 illustrates a recessed frame region for a film bulk acoustic wave resonator having an undulating outer perimeter;

FIG. 5 illustrates a recessed frame region for a film bulk acoustic wave resonator having an undulating inner perimeter;

What is claimed is:

CLAIMS

1. A film bulk acoustic wave resonator (FBAR) comprising a recessed frame region including an undulating perimeter, and a raised frame region including an undulating perimeter.

2. The FBAR of claim 1 wherein the undulating perimeter of the recessed frame region is an internal perimeter of the recessed frame region.

3. The FBAR of claim 2 wherein an outer perimeter of the recessed frame region is non-undulating.

4. The FBAR of claim 1 wherein the undulating perimeter of the recessed frame region is an outer perimeter of the recessed frame region.

5. The FBAR of claim 4 wherein an inner perimeter of the recessed frame region is non-undulating.

~~6. The FBAR of claim 4 further comprising a raised frame region including an undulating perimeter.~~

~~7~~6. The FBAR of claim 1 wherein the recessed frame region includes both an undulating inner perimeter and an undulating outer perimeter.

~~8. The FBAR of claim 6 further comprising a raised frame region including an undulating perimeter.~~

~~9~~7. The FBAR of claim ~~8~~ 1 wherein the raised frame region includes an undulating inner perimeter.

~~10~~8. The FBAR of claim 6 wherein undulation of the inner perimeter is in phase with undulation of the outer perimeter.

~~11~~9. The FBAR of claim 6 wherein undulation of the inner perimeter is out of phase with undulation of the outer perimeter.

~~12. The FBAR of claim 11 further comprising a raised frame region including an undulating perimeter.~~

~~13~~10. The FBAR of claim ~~12~~ 9 wherein the raised frame region includes an undulating inner perimeter.

~~14~~11. The FBAR of claim 1 wherein undulation of the perimeter of the recessed frame region is periodic.

~~15~~12. The FBAR of claim 1 wherein undulation of the perimeter of the recessed frame region is non-periodic.

~~16~~13. The FBAR of claim 1 where the recessed frame region is apodized.

~~17~~14. The FBAR of claim 1 where the recessed frame region is non-apodized.

~~18~~15. A radio frequency filter comprising a film bulk acoustic wave resonator (FBAR) having a recessed frame region including an undulating perimeter, and a raised frame region including an undulating perimeter.

~~19~~16. An electronics module comprising a radio frequency filter including a film bulk acoustic wave resonator (FBAR) having a recessed frame region including an undulating perimeter, and a raised frame region including an undulating perimeter.

~~20~~17. An electronic device comprising an electronics module including a radio frequency filter having a film bulk acoustic wave resonator (FBAR) with a recessed frame region including an undulating perimeter, and a raised frame region including an undulating perimeter.