Abstract

Chapter 1

Introduction

1.1   Introduction

Chapter 2

Methodology
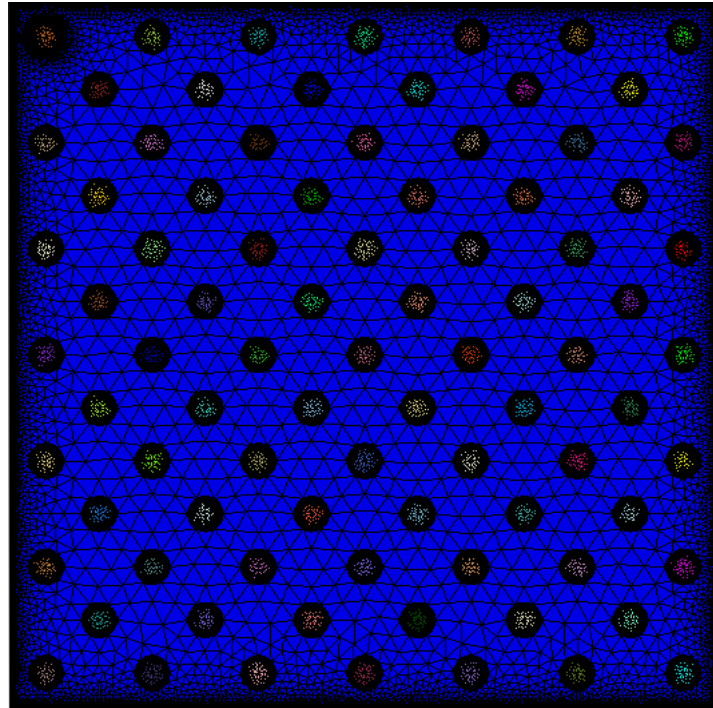
2.1 Introduction

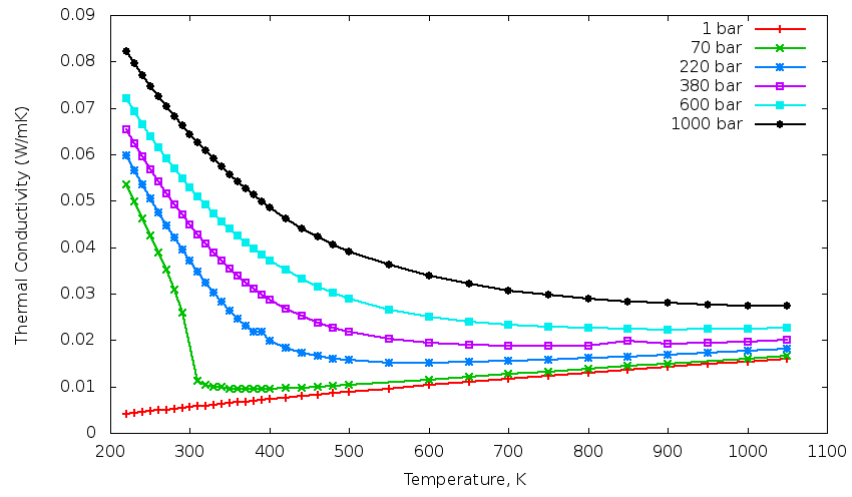Figure 2.1: Meshed Xenon bubble inside U-10Mo matrix

Figure 2.2: Thermal Conductivity of Xenon with increasing pressure

Chapter 3

Results

3.1   Results

In this study, heat conduction simulations were used to study the impact of over-all heat transfer coefficient in the presence of Xenon bubble in the intragranular region. Grain boundary resistance and the influence of intergranular fission is not included in this calculation. This simulation is design to see the impact on heat transfer due to the formation of Gas Bubble Superlattice. Bubble superlattice formation inside U-Mo fuel stabilizes the fuel swelling behavior but heavily impacts the heat transfer capability [1]. This might be due to Xenon's very low thermal conductivity. Thermal properties of Xenon was also considered in this work. Xenon's thermal conductivity is function of both temperature and pressure [3]. Since the size the of the bubble changes with the burnup and fission density, thermal conductivity of the bubble also changes [2]. Pressure inside the bubble is highly depend on the curvature of the bubble.
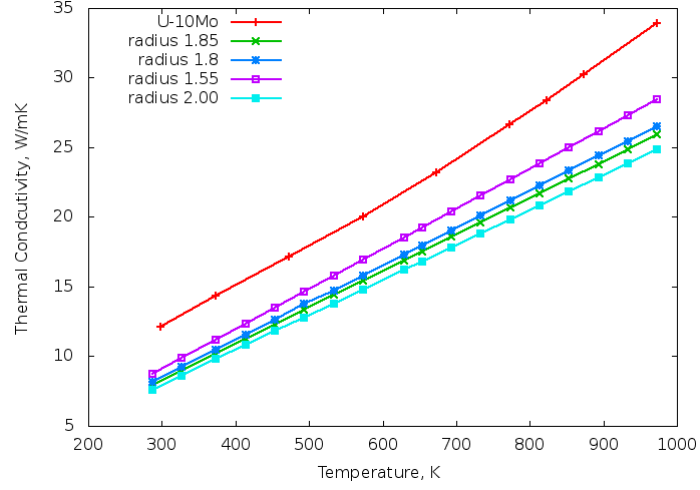
Figure 3.1: Comparison between the thermal conductivity of U-10Mo and the inclusion of Xe bubble of different sizes

FEM calculations were performed on 2.1 in order to calculate the thermal flux and the thermal conductivity in 2D.

Chapter 4

Discussions and conclusions

Chapter 5

Acknowledgments

Bibliography

[1] Douglas E Burkes et al. "Thermal properties of U–Mo alloys irradiated to moderate burnup and power". In: *Journal of Nuclear Materials* 464 (2015), pp. 331–341.

[2] Brandon D Miller et al. "Advantages and disadvantages of using a focused ion beam to prepare TEM samples from irradiated U–10Mo monolithic nuclear fuel". In: *Journal of Nuclear Materials* 424.1 (2012), pp. 38–42.

[3] Viktor Abramovich Rabinovich et al. "Thermophysical properties of neon, argon, krypton, and xenon". In: (1987).

Appendix A

XYZ Algorithm

```
clc
clear all
NN=input('Input the value of N');
%———next 13 lines assign an index IG to each basis function
C=zeros(3,3,3,3);
IG=0;
for I=1:3
    for L=1:NN+1
        for M=1:NN+1
            for N=1:NN+1
                if (L+M+N > NN+3), break, end
                IG=IG+1;
                IC(IG)=1;
                LB(IG)=1;
                MB(IG)=1;
                NB(IG)=1;

            end
        end
    end

end
rank=0.5*(NN+1)*(NN+2)*(NN+3);
NR=IG;
Gamma=zeros(rank,rank);
for IG=1:NR
    for JG=IG:NR
        I=IC(IG);
        J=IC(JG);
        LS=LB(IG)+LB(JG);
        MS=MB(IG)+MB(JG);
        NS=NB(IG)+NB(JG);

        Gamma(IG,JG)=C(I,1,J,1)*LB(IG)*LB(JG)*func(LS-2,MS,NS)+...
```

```
            C(I,2,J,2)*MB(IG)*MB(JG)*func(LS,MS-2,NS)+...
            C(I,3,J,3)*NB(IG)*NB(JG)*func(LS,MS,NS-2)+...
            C(I,1,J,2)*LB(IG)*MB(JG)+...
            C(I,2,J,1)*MB(IG)*LB(JG)*func(LS-1,MS-1,NS)+...
            C(I,1,J,3)*LB(IG)*NB(JG)+...
            C(I,3,J,1)*NB(IG)*LB(IG)*func(LS-1,MS,NS-1)+...
            C(I,2,J,3)*MB(JG)*NB(IG)+...
            C(I,3,J,2)*NB(IG)*MB(JG)*func(LS,MS-1,NS-1);
        Gamma(JG,IG)=Gamma(IG,JG);
      if(I==J) E(IG,IG)=func(LS,MS,NS)  ;
        end
end
end


[vects vals]=eig(E\Gamma);
```